Journal of the Kansas Entomological Society

(Central States Entomological Society)

Vol. 34 July, 1961 Number 3

PUBLICATION COMMITTEE

MARY H. MICHENER, Editor, Lawrence

R. E. BEER, Lawrence R. H. PAINTER, Manhattan

LLOYD O. WARREN, Fayetteville, Ark.

HARRY RAY BRYSON
1892-1956

Second class postage paid at Manhattan, Kansas.

JOURNAL OF THE KANSAS ENTOMOLOGICAL SOCIETY

A quarterly journal published in January, April, July, and October, devoted to Entomology in the Western Mississippi Basin and the proceedings of the Kansas Entomological Society.

Manuscripts for publication may be sent to Mrs. Mary H. Michener, Editor, care of the Department of Entomology, The University of Kansas, Lawrence, Kansas, or to any member of the publication committee.

The Kansas Entomological Society does not make exchanges since the Society does not maintain a library.

Subscriptions to the Journal must be paid in advance. The subscription rate is so low that second notices are not ordinarily sent out.

Payment of Canadian or other foreign subscriptions and bills must be made by international Postal Money Order or by a draft on a New York bank and payable in U.S.A. dollars.

Subscribers are urged to give us their full cooperation in these matters.

Subscriptions should be sent to Carl W. Rettenmeyer, Department of Entomology, Kansas State University, Manhattan, Kansas.

Subscriptions in the U.S.A.	**$3.00 per year**	**Single Copy**
Canadian or foreign subscriptions,	**$3.35 per year**	**$1.00**

KANSAS ENTOMOLOGICAL SOCIETY

President, C. C. BURKHARDT
Vice-President, W. E. LA BERGE
Secretary-Treasurer, CARL W. RETTENMEYER

Vol. 34, No. 3, July, 1961

This issue mailed September 25, 1961

Kansas Entomological Society
Vol. 34 July, 1961 Number 3

THE NASAL MITES OF THE GENUS *PTILONYSSUS* (Acarina: Rhinonyssidae) OCCURRING IN SOME NORTH AMERICAN PASSERIFORM BIRDS[1, 2]

JOHN EDWIN GEORGE

INTRODUCTION

This problem is a survey of the North American species of nasal mites belonging to the Genus *Ptilonyssus* and involves 12 species, all found in the nasal passages of passeriform birds. Seven of the species have been described as new. Parasitosis by the mites studied in the course of this problem involved 28 species of birds which were collected principally in Texas, but some of the specimens were taken from birds killed in the states of New Mexico, Georgia, Florida, North Carolina and California.

Types of all the new species are deposited in the Acarology collection of the U. S. National Museum, Washington, D. C.

I wish to thank Dr. R. W. Strandtmann, under whose guidance this work was done, for his longanimity and his help. I also want to thank Dr. D. W. Tinkle and Dr. Donald Ashdown for their advice and criticism.

MATERIALS AND METHODS

All of the specimens used in this study were contributed by different individuals to the mite collection kept by Dr. R. W. Standtmann in the zoology department at Texas Technological College. With the exception of three illustrations taken from other papers, the plates were made from original drawings of the mites. The mites were examined with the aid of a phase contrast microscope capable of magnifications of up to 970 diameters. A camera lucida attached to this scope was used as an aid in making the drawings. All measurements in this paper are in microns. The dimensions given are averages, followed in parentheses by the ranges.

GENUS *PTILONYSSUS*

Ptilonyssus Berlese and Trouessart, 1889
Generotyye: *Ptilonysus echinatus* Berlese and Trouessart, 1889:126.

The Genus *Ptilonyssus* is one of 17 genera of avian nasal mites belonging to the Family Rhinonyssidae (Mesostigmata). Taxonomists do not agree on the morphological characters which define the limits of membership in the genus. In this paper the Genus *Ptilonyssus* is considered to be only those mites of the Family Rhinonyssidae which have the following char-

[1] A thesis submitted to the Graduate Faculty of Texas Technological College, Lubbock, in Partial Fulfillment of the requirements for the degree of Master of Science. Present address: Department of Entomology, The University of Kansas, Lawrence.

[2] Supported by Grant E 616 from the National Institute of Allergy and Infectious Diseases, U. S. Public Health Service.

acteristics: females with two dorsal plates, one podosomal and one pygidial; female chelicera with a broad basal portion that curves abruptly toward the dorsum and then continues as an atennuated structure whose length usually represents approximately two-thirds of the total length of the chelicera. This defines *Ptilonyssus sensu strictu* and is the subgenus *Ptilonyssus* of de Castro (1948).

Members of this genus are elongated and frequently somewhat constricted medially. They are medium sized mites (body length of female 530-1090), poorly sclerotized, and have dorsolateral stigmata with short peritremes. A detailed description of the characters common to all species follows.

FEMALE. *Venter.* A distinct sternal plate is lacking, but the sternal area lacks striations and three pairs of sternal setae are present. Some species of *Ptilonyssus* have two pairs of pores associated with the first two pairs of sternal setae. The genital plate is usually about one-third longer than it is wide. The posterior border is generally rounded but may be pointed. A membranous anterior border covers the semielliptical genital opening. A pair of small setae and sometimes a pair of pores are located on or near the posterolateral margin of the genital plate. The anal plate may be oval or pear-shaped, with either two or three setae. The number and disposition of setae on the opisthosoma varies considerably from species to species. The striations on the non-sclerotized portion of the venter form a characteristic pattern.

Dorsum. There are two plates, a podosomal and a pygidial. The podosomal plate varies in size, shape, degree of sclerotization and in the number and arrangement of setae. The setae are small and blunt. Two to five pairs of setae flank the plate and a pair of setae often will be found immediately posterior to it. The stigma and small peritreme are located anterior to legs IV near the lateral margin of the podosoma. The pygidial plate is small and always has two small setae near its posterior margin. The plate is generally entire, but may be divided. An average of nine pairs of setae are distributed on the opisthosoma and striations are conspicuous on parts of the dorsum not covered by the plates.

Gnathosoma. It is about one-fifth as long as the idiosoma. The movable segments of the pedipalps are approximately as long as the fused coxae. The setae on the gnathosoma, with the exception of those on the palp tarsus, are consistent in their general pattern of location. Setae on the palp tarsus vary in number and arrangement from species to species and the two-tined seta usually present may be replaced by a large acuminate seta. The arrangement of setae on the rest of the gnathosoma and on the hypostome conform to the usual pattern. The chelicera (Fig. 3) has a broad basal portion that curves abruptly toward the dorsum and then continues as an atennuated structure two-thirds the total length of the chelicera. The number of deutosternal teeth varies from seven to eleven. The membranous tectum usually extends to the pedipalpal genu. The rounded anterior margin of the tectum may be smooth, but is more commonly fringed.

Legs. The arrangement of setae on the legs varies only slightly from one species to another, but the size and shape of the setae varies appreciably.

The dorsum of the genu is usually equipped with four almost identical setae, but on some mites the setal plates of the two posterior setae are enlarged to about twice the usual diameter. On the dorsal apex of tarsus I, there is a compact cluster of five sensory setae, two sharp-pointed and three blunt. A varying number of setae are associated with the sensory setae and their distribution and size do not often differ discernibly.

MALE. On the dorsum the podosomal area with its plate does not differ to any great extent from the female. On the opisthosoma this is not the case. There is always an irregularly shaped plate located between the podosomal plate and the area which on the male may or may not be occupied by the pygidial plate. The number and distribution of setae on the dorsum of the opisthosoma is unlike the female. The male genital opening, between coxae II, is conspicuous. No ventral plates can be distinguished; the area usually occupied by the ventral plates lacks striations, but has the usual ventral setae. There are no variations between the male and female in the ventral opisthosomal area. The male chelicera is cylindrical, but tapers slightly to the point where the slender, well developed chela begins. The movable member of the chela is two tined; one tine is the spermatodactyl.

IMMATURE FORMS. The larvae are weakly sclerotized and devoid of plates. The legs are short and most of the segments are broader than long. The majority of the setae on the larvae are minute and difficult to see. The larval chelicerae are cylindrical and have poorly developed chelae. They appear to be non-functional and it is highly probable that the larval stage does not feed. The protonymph and the deutonymph, excepting their lack of a genital plate and opening, are similar to the female. The majority of the setae in the nymphs are smaller than those on the adults. The protonymphal pygidial plate is sometimes comparable to the same plate in the female except it bears two long pilose setae (Fig. 89). In other protonymphs the plate is larger than the same plate in the female, irregular in shape, and equipped with two short, spiny setae (Fig. 24). The protonymphal chelicerae (Fig. 28) are smaller than the female's, but are almost identical in other respects. The pygidial plate of the deutonymph may be represented by two long pilose setae (Fig. 48) which are more heavily constructed than similar setae on the protonymph and arise from an irregularly striated area. In other instances the pygidial plate is large, irregular in shape and provided with two short, blunt setae. The deutonymphal chelicerae are cylindrical from the base to the poorly developed chelae, and do not appear to be functional. The deutonymph probably does not feed.

Key to the North American Species of the Genus *Ptilonyssus* Based on the Females

1. Two setae on anal plate 2
   Three setae on anal plate 3
   Four pairs of blunt setae on venter of opisthosoma and a long frayed seta near distal end of tarsus I. ..... *P. perisorei* n. sp.
   Seven pairs of acuminate setae on venter of opisthosoma ..... *P. lanii* Zumpt & Till

3. The three anal setae located posterior to anal opening 4
   Anal setae not all posterior to anal opening 9
4. Genital plate very narrow and pointed posteriorly 5
   Genital plate at least one-third as wide as it is long and rounded posteriorly 6
5. Inflated blunt setae located on venter of coxae, trochanters and femora ..... *P. echinatus* B. & T.
   Each coxa, trochanter and femur bearing flame-shaped setae which taper to long fine points ..... *P. tachycinetae* n. sp.
6. Weakly sclerotized sternal plate present ..... *P. nudus* B. & T.
   Without sternal plate 7
7. Elongated anal plate with three blunt setae. Six pairs of blunt setae on venter of opisthosoma ..... *P. mimi* n. sp.
   Three setae on anal plate acuminate 8
8. Five pairs of slender acuminate setae on venter of opisthosoma. Podosomal plate bears seven pairs of setae. Three pairs which are moderately long and slightly pointed are located near the antero-lateral margins of the plate; the other four pairs on the plate are minute and blunt ..... *P. richmondenae* n. sp.
   Seven pairs of prominent acuminate setae on venter of opisthosoma. Six pairs of blunt setae on podosomal plate ..... *P. sialiae* n. sp.
9. More than four pairs of setae on podosomal plate. With two-tined seta on palp tarsus 10
   Only four pairs of small blunt setae on podosomal plate. Two pairs of spine-like setae with their distal ends curved toward body located on anterior edges of tarsi III and IV ..... *P. salpinctus* n. sp.
10. Podosomal plate bell-shaped. Three long slender setae on anal plate. Five pairs of blunt setae on venter of opisthosoma and a pair of acuminate setae on posterior margin of opisthosoma ..... *P. phainopeplae* n. sp.
    Podosomal plate not bell-shaped 11
11. All setae on podosomal plate usually minute. Occasionally a pair of large setae may be located on the postero-lateral margin of the plate ..... *P. sairae* Castro
    The four pairs of setae nearest the lateral margin of podosomal plate of medium size, the other four pairs of setae on the plate minute ..... *P. japuibensis* Castro

DESCRIPTION OF SPECIES

Ptilonysus perisorei, new species

Figs. 1-13

FEMALE (Figs. 1-5). Length of idiosoma, 748 (690-830); width, 420 (400-450). Length of podosomal plate, 286 (270-300); width, 250 (230-280). Length of pygidial plate, 36 (31-41); width, 105 (101-115). Length of genital plate, 168 (163-170); width, 100 (94-110). Length of anal plate, 136 (130-146); width, 81 (74-86).

The sternal and genital setae, along with the eight pairs of setae present on the opisthosoma, are blunt. One pair of small, blunt setae is located on the anal plate posterior to the anal opening. On the legs the ventral setae are blunt and relatively short. On the distal end of tarsus I a seta (Fig. 4) which is situated proximally to the cluster of five specialized setae, is long and its distal end has a frayed appearance. The setal plates of the two posterior dorsal setae on genu III are enlarged to approximately twice the diameter of the other setal plates (Fig. 5). (For an enlarged view, see Fig. 67, which is similar but of another species.) The podosomal plate has seven pairs of small, blunt setae located on its surface and three setae flanking each side of the plate. Sixteen setae and a pygidial plate which is roughly elliptical in shape are present on the opisthosoma.

MALE (Figs. 6, 11-13). The palp tarsus (Fig. 6) differs slightly from the palp tarsus of the female (Fig. 2). The male has two setae slightly longer than the others; in the female all setae are equally short. On the dorsum the male has a lightly sclerotized plate (33μ wide and 43μ long) located between the podosomal and pygidial plates. The plate is almost quadrangular in shape. Four pairs of setae, not present on the female, are distributed in the opisthosomal area near the pygidial plate.

IMMATURE FORMS (Figs. 7-10). Except for the long, pilose pygidial setae and the absence of genital plates, the nymphs are similar to the female. The protonymphal pygidial setae measure 17x3 and the deutonymphal setae measure 19x4.

Host and locality. Canada jays *(Perisoreus canadensis)* collected near Santa Fe, New Mexico, November 27, 1955, by R. W. Strandtmann.

Types. The mite was described from the holotype female, 16 paratype females, four paratype males and two paratype nymphs.

Remarks. Only one other species *(P. lanii)* in the genus has only two setae in the anal plate. *P. perisorei* is easily distinguished because it has eight setae on the venter of the opisthosoma, *P. lanii* has 14. No other mite in the genus has the long, frayed seta on tarsus I.

Nine mites of this species were found in specimens of Steller's jay *(Cyanocitta stelleri)* collected in Glorietta Pass, New Mexico, September 11, 1951, by H. B. Morlan. Size is the only discernible difference between these mites and those taken from the Canada jay. On the average, the female specimens from the Stellar's jay were 20% longer and wider than the females found in the Canada jay. The plates are in the same ratio of size to body size in this mite as they are in the mites from the Canada jay.

Ptilonyssus phainopeplae, new species

Figs. 14-18

FEMALE (Figs. 14-18). Length of idiosoma, 708 (620-750); width, 393 (320-430). Length of podosomal plate, 235 (210-260); width, 235 (210-260). Length of pygidial plate, 52 (41-74); width, 87 (82-94). Length of anal plate, 110 (97-125); width, 75 (70-86). Length of genital plate, 127 (120-134); width, 66 (65-67).

All the setae, excepting those on the anal plate and a pair situated on the posterior margin of the mite, are blunt. The setae on the posterior

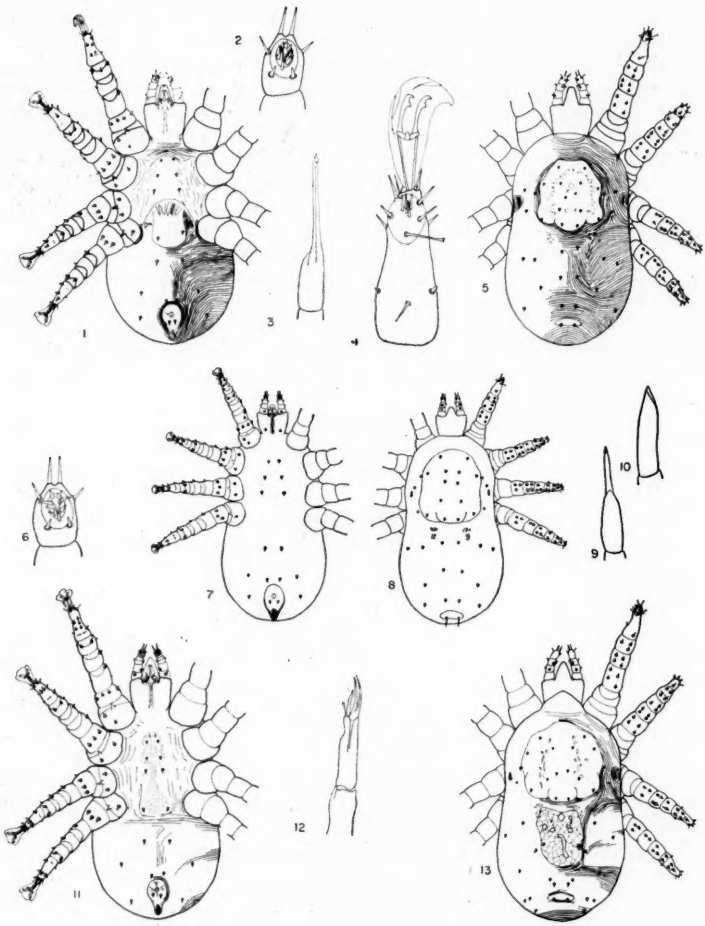


PLATE I

P. perisorei: Fig. 1, ventral view of female; Fig. 2, ventral view of female palp tibia and tarsus; Fig. 3, female chelicera; Fig. 4, dorsal view of tarsus 1; Fig. 5, dorsal view of female; Fig. 6, ventral view of male palp tibia and tarsus; Fig. 7, ventral view of protonymph; Fig. 8, dorsal view of protonymph; Fig. 9, chelicera of protonymph; Fig. 10, chelicera of deutonymph; Fig. 11, ventral view of male; Fig. 12, chelicera of male; Fig. 13, dorsal view of male.

margin are acuminate; the three setae on the anal plate taper abruptly from their base to a long, fine point. The paired anal setae are just anterior to the anal opening and the odd anal seta is immediately posterior to the

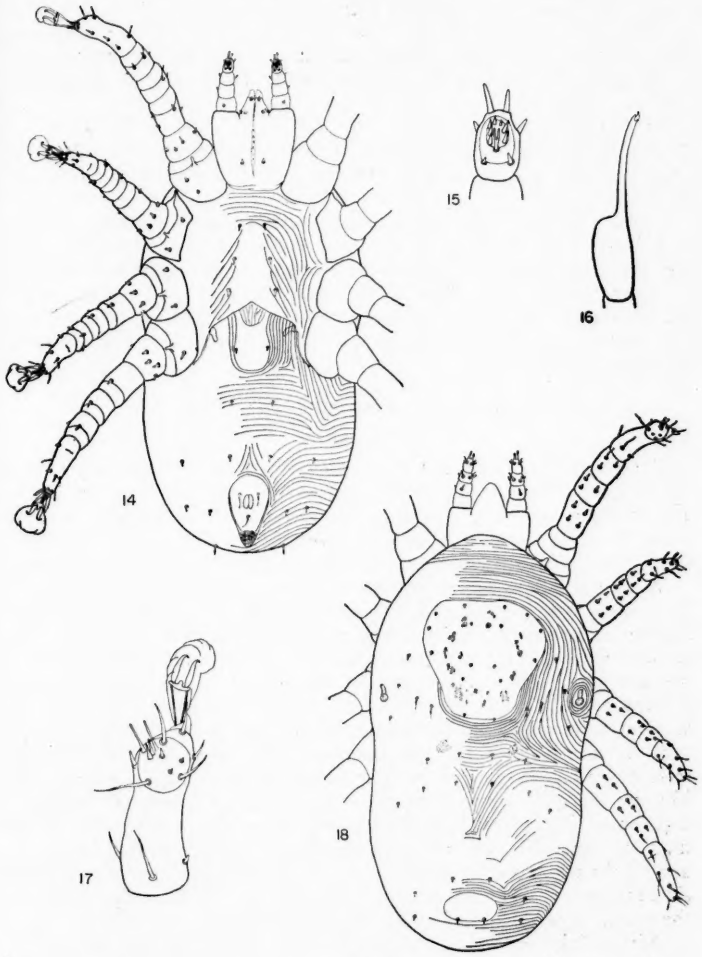


PLATE II

P. phainopeplae: Fig. 14, ventral view of female; Fig. 15, ventral view of female palp tibia and tarsus; Fig. 16, chelicera of female; Fig. 17, dorsal view of tarsus I; Fig. 18, dorsal view of female.

opening. Counting the pointed pair of setae on the posterior margin, six pairs of setae are located on the venter of the opisthosoma. The setae on the coxae and trochanters are blunt, but on the more distal segments of the legs the setae gradually become more pointed. The podosomal plate is shaped roughly like a bell and has eight pairs of small setae on its surface. Five setae flank the sides of the plate; two taper abruptly to a fine point and three are blunt. Eight pairs of setae are distributed on the opisthosoma and an elliptic pygidial plate is located near the posterior border of the body.

MALE. Unknown.

IMMATURE FORMS. Unknown.

Host and locality. A Phainopepla *(Phainopepla nitens)* collected in Val Verde Co., Texas, on March 7, 1958, by R. W. Strandtmann and D. L. Brooks.

Types. Described from the holotype female and three paratype females.

Remarks. The combination of characters which distinguish this mite from other species in the genus are a bell-shaped podosomal plate and the five pairs of setae which flank it, the five blunt pairs and one acuminate pair of setae on the venter of the opisthosoma, the location of the paired anal setae anterior to the anal opening and the odd anal seta immediately posterior to the opening.

Ptilonyssus tachycinetae, new species

Figs. 19-29

FEMALE. (Figs. 19-22, 29). Length of idiosoma, 720 (700-750); width, 380 (370-390). Length of podosomal plate, 160 (the length of each of the three plates measured was 160); width, 117 (110-120). Length of pygidial plate, 38 (36-41); width, 74 (67-84). Length of anal plate, 128 (122-134); width, 56 (50-62). Length of genital plate, 146 (144-149); width, 13 (12-14).

A pore is located posterolaterally to each of the first four sternal setae. The sternal setae are grouped compactly and the area the setae surround is lightly and irregularly striated. The genital plate is extremely narrow and its posterior end is pointed. A pair of setae and a pair of pores are located laterally to the plate. The venter of the opisthosoma supports 12 finely pointed setae. The anal plate is shaped like an elongated hen's egg. The anal setae taper to a fine point and are slightly larger than those which surround the plate. Each coxa, trochanter and femur bears flame-shaped setae which taper to fine points. The remainder of leg segments bear thorn-like setae on their venters. The podosomal plate is a quadrangle which has eight small, blunt setae located on it and its surface is divided by narrow lines into small irregular areas. Sixteen blunt setae are located in the area around the plate, two are situated in front of the plate, two behind it and six flank each side. Eleven pairs of blunt setae are found on the dorsum of the opisthosoma. The pygidial plate is crescent-shaped.

MALE. Unknown.

IMMATURE FORMS (Figs. 23-28). The sternal setae of the protonymph are smaller than those on the female and are spread over a larger area than the sternal setae of the female. Four pairs of setae are located on the opisthosoma. The anal plate is shorter than the one on the female. The

setae on coxa I are short and pointed. The posterior seta on coxa II and III is long and tapers to a fine point and the anterior seta is short and blunt. A single long, finely-pointed seta is present on coxa IV. The setae on all trochanters are each distinctly different in size and shape from one

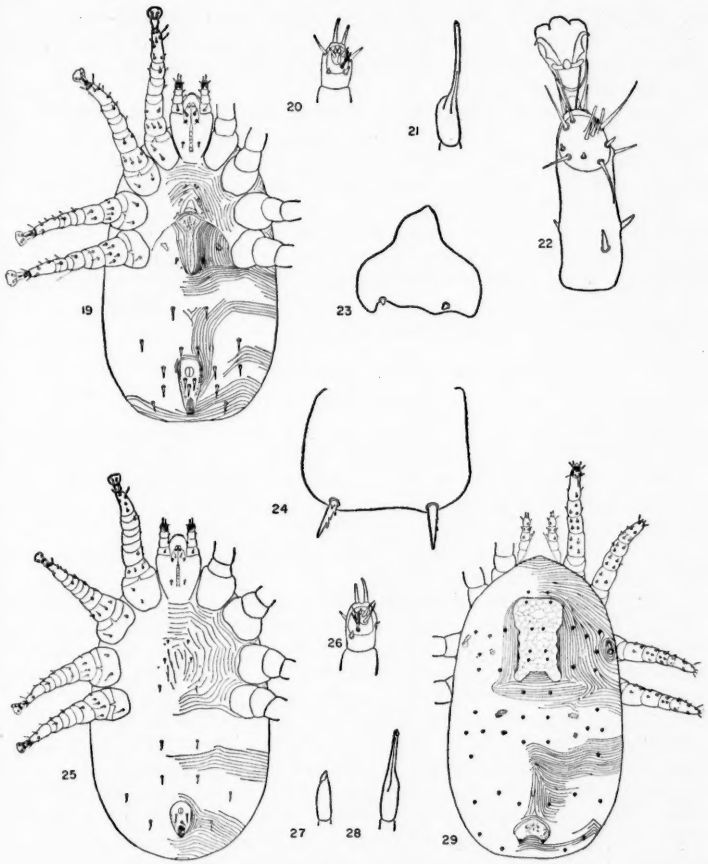


PLATE III

P. tachycinetae: Fig. 19, ventral view of female; Fig. 20, ventral view of female palp tibia and tarsus; Fig. 21, chelicera of female; Fig. 22, dorsal view of tarsus 1; Fig. 23, pygidial plate of deutonymph; Fig. 24, pygidial plate of protonymph; Fig. 25, ventral view of protonymph; Fig. 26, ventral view of protonymph palp tibia and tarsus; Fig. 27, chelicera of deutonymph; Fig. 28, chelicera of protonymph; Fig. 29, dorsal view of female.

another. Setae which are borne on the remaining segments of the legs are smaller than the same setae on the female, but are in approximately the same location. On the dorsum the shape and size of the pygidial plate and setae are the most significant variations of the protonymph from the female. The irregularly shaped pygidial plate and the blunt setae which are located on its posterior margin are illustrated in Figure 23. The two lateral setae on the palp tarsus of the protonymph are much longer than the same setae on the female. On the deutonymph the pygidial plate (Fig. 24) is quadrangular, its anterior margin is indistinct and the phygidial setae are large and irregularly serrated.

Host and locality. The tree swallow *(Tachycineta bicolor)* collected by R. O. Albert in Florida City, Florida, on September 10, 1954.

Types. The mite was described from the holotype female, six paratype females, one paratype protonymph and one paratype deutonymph.

Remarks. This mite is undoubtedly closely related to *P. echinatus* and many features such as the sternogenital area, the podosomal plate, and the shape of the anal plate are comparable. Most obvious differences are the shape, size and number of setae present on the venter of the opisthosoma, the shape of the setae on the anal plate and the shape of the setae on the venter of the first three segments of each leg.

Ptilonyssus echinatus Berlese and Trouessart

Figs. 30-32

Berlese and Trouessart, 1889:126; Vitzthum, 1935:578; Pereira and Castro, 1949:219; Zumpt and Till, 1955:74, Fain, 1956:136; Fain, 1956:114.

FEMALE. (Figs. 30-32). Length of idiosoma, 817 (670-920); width, 427 (370-480). Length of podosomal plate, 175 (170-180); width, 110 (100-120). Length of pygidial plate, 24; width, 58. Length of anal plate, 142 (134-153); width, 14 (only two plates were in good enough condition to measure and they were identical in size).

The sternal setae are compactly grouped and the area between the setae is irregularly striated. A pore is located posterolaterally to each of the first four sternal setae. The pointed genital plate is very narrow and is flanked by a pair of thickset setae, each seta having a pore located anterolaterally to it. The anal plate is shaped like an elongated hen's egg. It bears three large spike-like setae posterior to the anal opening. The remainder of the opisthosoma bears an average of 11 pairs of setae (ranges from 9-13) almost identical to those on the anal plate. One of the most striking features of the mite is the inflated, blunt setae located on the venter of the coxa, trochanter and femur of each leg. Spine-like setae are on the remaining leg segments. Eight blunt setae are located on the quadrangular podosomal plate and five pairs of blunt setae bound the plate; a pair anterior, one pair posterior and three pairs laterally. Out of seven mites only one has an entire pygidial plate; the other six have only a small area sclerotized around each pygidial seta. Dorsally the opisthosoma supports 11 pairs of blunt setae.

MALE. Unknown.

IMMATURE FORMS. The small number of nymph slides are in poor

condition and do not reveal any especially distinctive morphological features. Two long, pilose pygidial setae on a moulting protonymph were the only parts of any pygidial plate and setae which were discernible.

Host and locality. Six females and two nymphs were present in a barn swallow *(Hirundo rustica)* collected by R. O. Albert on September 10, 1954, in Florida City, Florida; four females and two nymphs were found in the nasal passages of two cliff swallows *(Petrochelidon pyrrhonota)* both collected by R. B. Loomis, one is Crosby Co., Texas, on July 14, 1950,

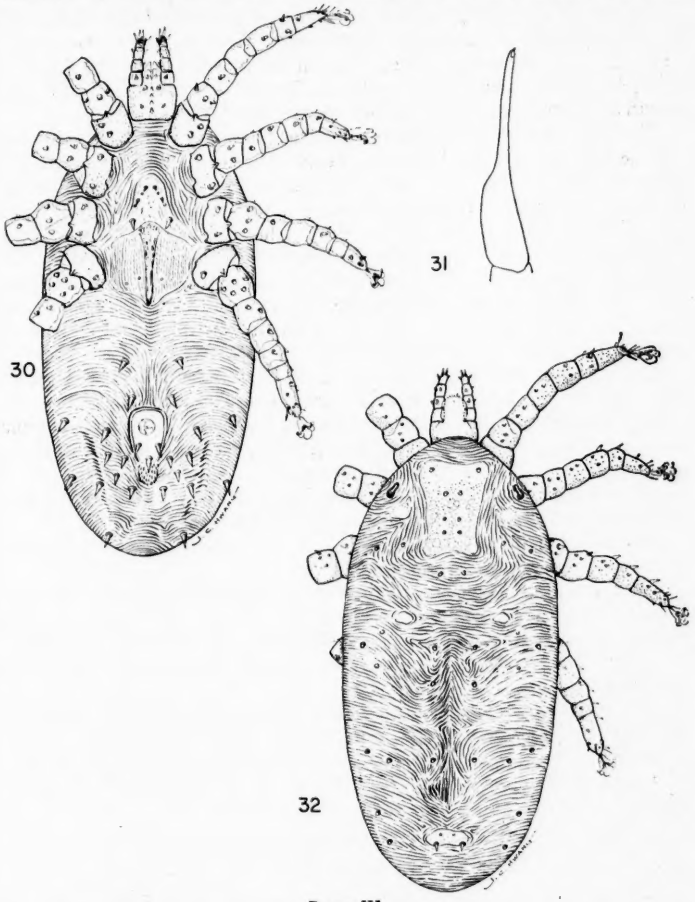


PLATE IV

P. echinatus: Fig. 30, ventral view of female; Fig. 31, chelicera of female; Fig. 32, dorsal view of female. (Original by J. C. Hwang.)

and the other in Douglas Co., Kansas, on September 10, 1951. The type host is *Hirundo rustica* collected in Germany.

Remarks. The shape of setae on the anal plate, the number and shape of setae on the venter of the opisthosoma and the inflated setae on the coxae, trochanters and femora are a unique combination of characters.

Ptilonyssus salpinctis, new species

Figs. 33-37

FEMALE (Figs. 33-37). Length of idiosoma, 645 (610-700); width, 310 (300-330). Length of podosomal plate, 120; width, 120 (out of four specimens only one was measurable). Length of pygidial plate, 39 (29-53); width, 44 (36-50). Length of anal plate, 120 (118-122); width, 58 (55-60). Length of genital plate, 140 (139-142); width, 76 (72-84).

The three pairs of sternal setae are stout and acuminate. The anal plate is shaped like an elongated pear and bears three large spine-like setae. The paired setae are located even with the anterior edge of the anal opening; the odd anal seta is located immediately posterior to the opening. Eight pairs of spine-like setae are distributed over the remainder of the opisthosomal venter. On the ventral sides of the legs most of the setae ar smaller, but similar in shape to the ones on the opisthosoma. Two pairs of spine-like setae with their bases perpendicular to the leg and their distal ends curving toward the body of the mite are located on the anterior edges of tarsi III and IV. The podosomal plate is very lightly sclerotized and sometimes its margins are not seen easily. Four pairs of blunt setae are located on the plate, one pair is located posteriorly and two pairs flank the podosomal plate. The pygidial plate is small and has a pore anterior to each pygidial seta. The shape of the plate varies considerably. Eleven pairs of blunt setae are on the dorsal surface of the opisthosoma. A two-tined palp seta is absent and the position it usually occupies is filled by an acuminate seta. Only two other setae are present on the palp tarsus.

MALE. Unknown.

IMMATURE FORMS. Unknown.

Host and Lociality. Two rock wrens *(Salpinctes obsoletus)*, both collected by D. L. Brooks, one in Brisco Co., Texas, on August 10, 1958 and the second collected in Lubbock Co., Texas, on September 24, 1950.

Types. The mite was described from a female holotype and four female paratypes.

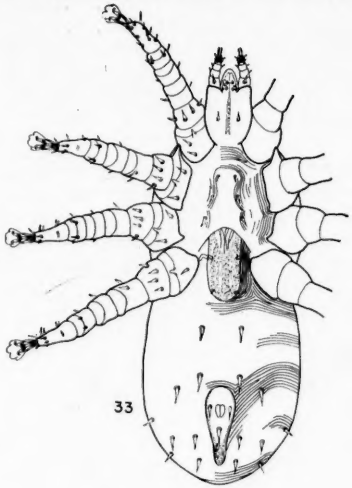
Remarks. The spine-like setae which are present on the venter of the mite, the unusual setae on the anterior edge of tarsi III and IV and the elongated anal plate are a distinctive combination of characters. The absence of a tined palp seta was not noted on any of the other North American species.

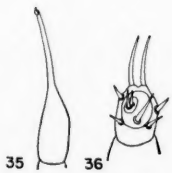
Ptilonyssus nudus Berlese and Trouessart

Figs. 38, 39

Berlese and Trouessart, 1889:126; Vitzthum, 1935:578; Castro and Pereira, 1947:127; Porter and Strandtmann, 1952:393; Zumpt and Till, 1955:79; Fain, 1956:144; Fain, 1956:100.

FEMALE. Length of idiosoma, 654 (620-680); width, 266 (260-280). Length of podosomal plate, 226 (220-230); width, 173 (150-190). Length of pygidial plate, 42 (41-43); width, 89 (78-98). Length of sternal plate, 104 (103-106); width, 83 (79-86). Length of genital plate, 105 (101-113); width, 49 (48-50). Length of anal plate, 98 (84-115); width, 49 (46-53).





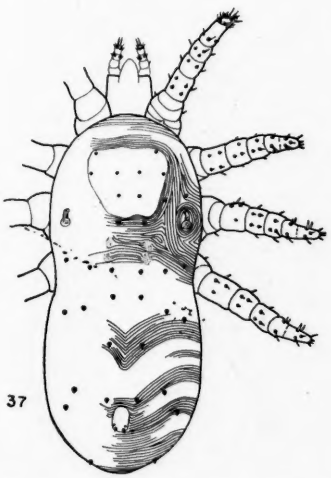


PLATE V

P. salpinctis: Fig. 33, ventral view of female; Fig. 34, dorsal view of tarsus 1; Fig. 35, chelicera of female; Fig. 36, ventral view of female palp tibia and tarsus; Fig. 37, dorsal view of female.

A lightly sclerotized sternal plate is present with three pairs of blunt setae located on its margins. The surface of the plate is divided by narrow lines into small irregularly shaped areas. The pearshaped anal plate bears three blunt setae, all of which are located posterior to the anal opening. Six pairs of blunt setae are situated in the area around the anal plate. The majority of the setae on the ventral surfaces of the legs are small and blunt. The normal number of setae are present on the coxae, but on trochanters I, III and IV there are two rather than the average four. The podosomal plate is large, weakly sclerotized and bears nine pairs of minute setae on its surface. Two pairs of pointed setae flank the plate. A semi-circular pygidial plate and 12 pairs of setae are present on the opisthosoma.

MALE. No males were available.

IMMATURE FORMS. The pygidial plate of the protonymph is similar to the female's, but the setae are long and slightly pilose. Only one deutonymph is available and its posterior end is wrinkled badly enough to prevent close examination of its pygidial plate and long, pilose setae.

Host and locality. English sparrows *(Passer domesticus)* collected by R. W. Strandtmann and J. C. Porter on July 20, 1949, and July 21, 1950, respectively. Three females, one male, two larvae, two protonymphs, and

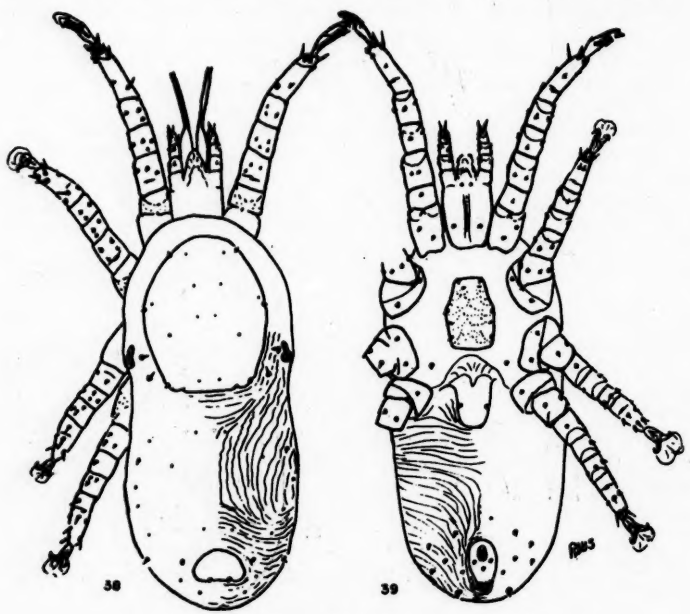


PLATE VI

P. nudus: Fig. 38, dorsal view of female; Fig. 39, ventral view of female. (From Porter and Strandtmann, 1952.)

four deutonymphs were examined. The type host is *Passer domesticus* collected in France.

Remarks. It is easy to see the reason for Berlese and Trouessart's choice of a specific name. Literally the name is not accurate, but the small size and inconspicuousness of the setae is an impressive character. This mite is the only member of the genus which has a distinct sternal plate.

Ptilonyssus lanii Zumpt and Till

Figs. 40-42

Zumpt and Till, 1955:79; Fain, 1956:143; 1957b:103; 1957c:1.

FEMALE. Length of idiosoma, 716 (650-780); width, 372 (360-390). Length of podosomal plate, 232 (230-240); width, 196 (180-210). Length

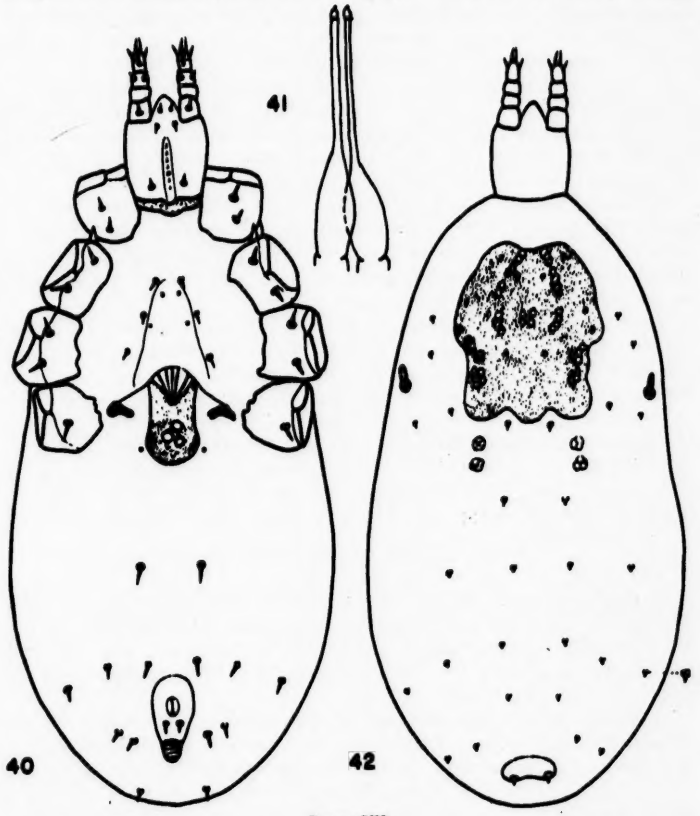


PLATE VII

P. lanii: Fig. 40, ventral view of female; Fig. 41, chelicera of female; Fig. 42, dorsal view of female. (From Fain, 1957.)

of pygidial plate, 41 (34-46); width, 94 (77-108). Length of anal plate, 128 (122-137); width, 76 (70-82). Length of genital plate, 131 (122-142); width, 75 (65-84).

A pore is associated with each of the first four sternal setae. Ventrally the opisthosoma bears seven pairs of sharp-pointed setae. On the pear-shaped anal plate, paired setae are situated posterior to the anal opening. The majority of the setae on the venters of the legs are thorn-like. The podosomal plate bears six pairs of blunt setae. The shape of the plate is illustrated (Fig. 42). Two pairs of blunt setae flank each side of the plate and one pair is located immediately posterior to the plate. The margin of the pygidial plate is irregular, but roughly kidney shaped.

MALE. The venter of the male opisthosoma differs from the female's in two respects: the pair of setae on the anal plate is located one on each side of the anal opening, and only five pairs of setae are present on the venter of the opisthosoma. Dorsally the semielliptical podosomal plate bears seven pairs of small setae and has three pairs flanking it. A weakly sclerotized plate which is 170μ long by 140μ wide is posterior to the podosomal plate. The posterior ends of the only two specimens available are wrinkled so badly as to prevent close examination of the pygidial plate. Eight setae were counted on the dorsal surface of the opisthosoma.

IMMATURE FORMS. The pygidial setae of the protonymph are long and pilose; the pygidial plate is comparable to the female's. On the dorsal surface of the single available deutonymph, a goblet-shaped plate which extends the length of the opisthosoma was observed. Two long pilose setae are located on the posterior margin of this plate.

Host and locality. A loggerhead shrike *(Lanius ludovicianus)* collected near Palacios, Texas, January 18, 1948, by R. W. Strandtmann. Twenty-one females, two males, two protonymphs and two deutonymphs were examined. The type host is *Lanius collaris* collected in Transvaal, South Africa.

Remarks. Ptilonyssus lanii and *Ptilonyssus perisorei* are the only members of the genus which have just two setae on the anal plate. The seven pairs of setae on the venter of the opisthosoma, the thorn-like setae on the legs and the four pores associated with the first four sternal setae are characters which *Ptilonyssus lanii* does not share with *Ptilonyssus perisorei.*

Ptilonyssus mimi, new species

Figs. 43-50

FEMALE. (Figs. 43, 46, 47, 50). Length of idiosoma, 832 (690-1070); width, 420 (340-460). Length of podosomal plate, 286 (280-300); width, 252 (240-260). Length of pygidial plate, 41 (36-46); width, 112 (108-120). Length of anal plate, 162 (156-172); width, 78 (74-84). Length of genital plate, 164 (154-172); width, 76 (65-91).

The anal plate is elongated and bears three blunt setae which are posterior to the anal opening. The six pairs of setae located on the opisthosoma near the anal plate are also blunt. With the exception of several setae on each tarsus, all of the setae of the venters of the legs are blunt. The shape of the prodosomal plate and the arrangement of the seven pairs of setae which are borne on the plate are illustrated in Figure 50. Two pairs of blunt setae flank the plate and a single blunt pair is situated posterior to it. Seven pairs

of blunt setae are located on the opisthosoma. The shape of the pygidial plate varies, but the crescent shape which is illustrated is reasonably typical. The three dorsal setae on the proximal end of tarsus I (Fig. 47) are short and blunt. The setal plates of the two posterior dorsal setae on genu III are enlarged.

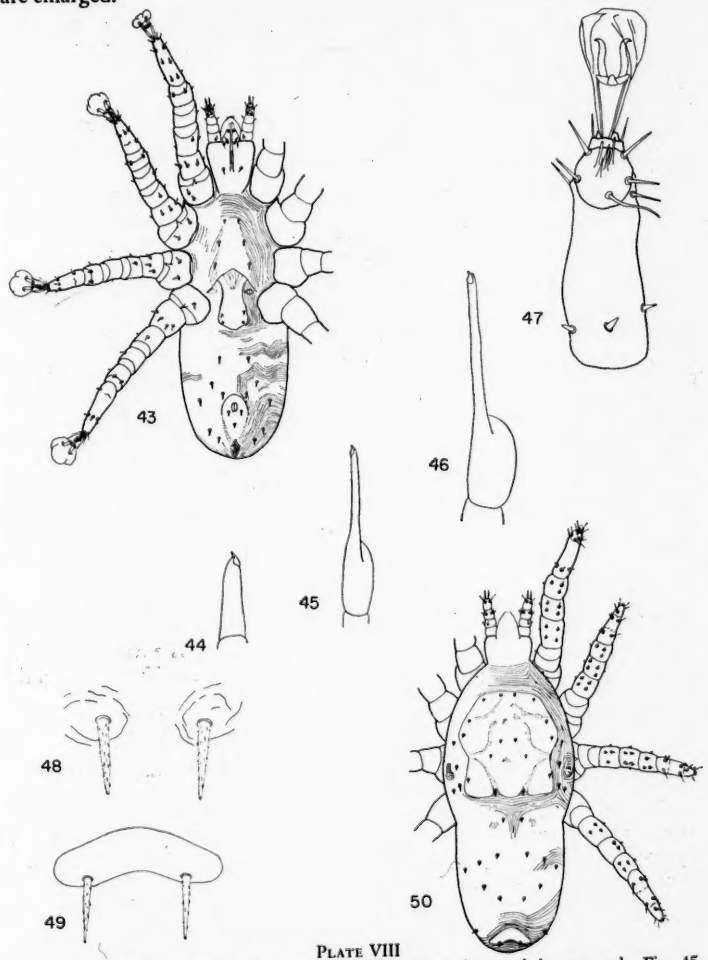


PLATE VIII

P. mimi: Fig. 43, ventral view of female; Fig. 44, chelicera of deutonymph; Fig. 45, chelicera of protonymph; Fig. 46, chelicera of female; Fig. 47, dorsal view of tarsus 1; Fig. 48, pygidial setae of deutonymph; Fig. 49, pygidial plate of protonymph; Fig. 50, dorsal view of female.

MALE. Unknown.

IMMATURE FORMS. (Figs. 44, 45, 48, 49). The pygidial plate of the protonymph bears two long, pilose setae and is shaped like the female's. A pygidial plate is lacking on the deutonymph, but two large pilose setae are located in the pygidial area.

Host and locality. Mockingbirds *(Mimus polyglottos)* collected by R. W. Strandtmann in Kingsville, Texas, November 25, 1959, and by D. L. Brooks in Val Verde Co., Texas, March 7, 1958.

Types. The mite was described from the holotype female, 16 paratype females, two paratype protonymphs and two paratype deutonymphs.

Remarks. The distinguishing features of this mite are the elongated anal plate, the six blunt pairs of setae on the venter of the opisthosoma and the three short setae on the dorsum of the proximal end of tarsus I.

Ptilonyssus sialiae, new species

Figs. 51-57

FEMALE (Figs. 51, 52, 54, 56, 57). Length of idiosoma, 780 (720-930); width, 380 (340-410). Length of podosomal plate, 244 (230-290); width, 178 (170-180). Length of pygidial plate, 44 (41-48); width, 96 (84-113). Length of anal plate, 129 (125-137); width, 70 (65-77). Length of genital plate, 149 (137-168); width, 79 (67-84).

The anal plate is pear-shaped and bears three sharp-pointed setae posterior to the anal opening. Seven pairs of acuminate setae are present on the venter of the opisthosoma. The palp tarsus bears only three setae in addition to the tined seta. Six pairs of small blunt setae occur on the weakly sclerotized podosomal plate, five blunt setae flank each side and a pair is borne posterior to it. The elliptical pygidial plate shares the dorsum of the opisthosoma with eight pairs of blunt setae.

MALE. Unknown.

IMMATURE FORMS (Figs. 53, 55). The larva and deutonymph are unknown. One specimen of a protonymph was available. Five setae are present on the venter of the protonymphal opisthosoma; the female has seven pairs. The shape of the pygidial plate is illustrated in Figure 55. The pygidial setae are short, stout and slightly pilose.

Host and locality. Mountain bluebirds *(Sialia currucoides)* collected by R. W. Strandtmann in Lubbock Co., Texas, December 30, 1950.

Types. The mite was described from the holotype female, nine paratype females and one paratype protonymph.

Remarks. This mite may be distinguished by the three setae on the palp tarsus, the seven pairs of pointed setae on the venter of the opisthosoma, the location of the anal setae posterior to the anal opening and the five pairs of blunt setae which flank the podosomal plate.

Ptilonyssus richmondenae, new species

Figs. 58-64

FEMALE. (Figs. 58, 59, 62, 64). Length of idiosoma, 866 (750-1090); width, 390 (340-450). Length of podosomal plate, 252 (210-270); width, 208 (180-240). Length of pygidial plate, 41 (37-48); width, 98 (87-110).

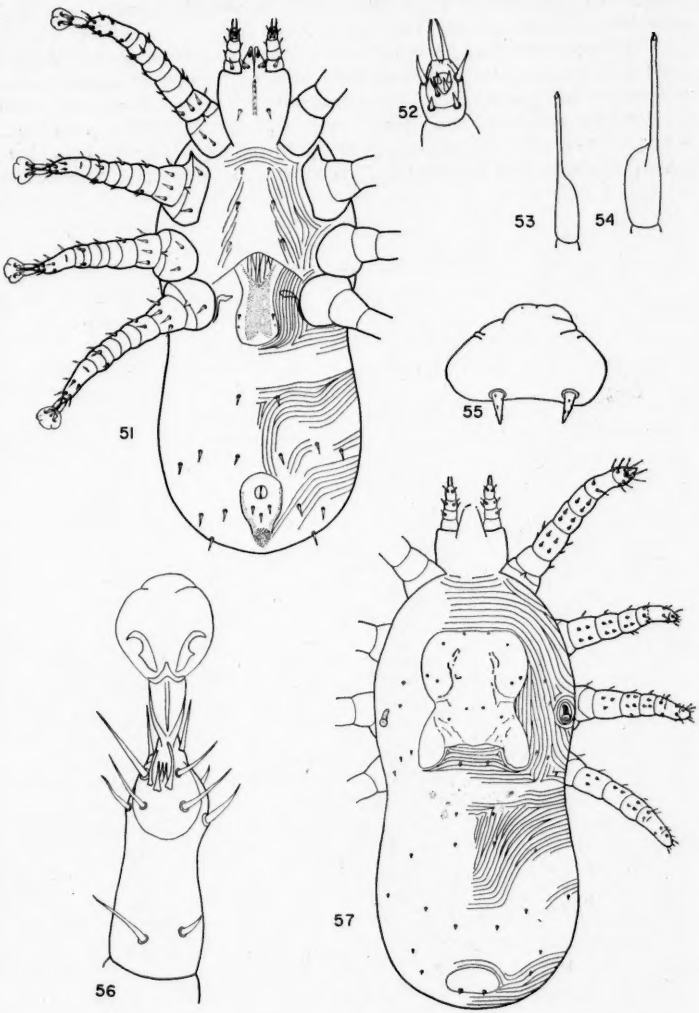


PLATE IX

P. sialiae: Fig. 51, ventral view of female; Fig. 52, ventral view of female palp tibia and tarsus; Fig. 53, chelicera of protonymph; Fig. 54, chelicera of female; Fig. 55, pygidial plate of protonymph; Fig. 56, dorsal view of tarsus 1; Fig. 57, dorsal view of female.

Length of anal plate, 125 (120-130); width, 72 (69-78). Length of genital plate, 138 (132-146); width, 71 (67-78).

The five pairs of setae located on the opisthosoma are slender and sharply pointed. The anal plate is pear-shaped and bears three setae similar to the ones on the opisthosoma. The paired anal setae are located almost even with the posterior margin of the large, circular anal opening, the unpaired seta is situated medially and posteriorly to the paired ones. The weakly sclerotized podosomal plate bears seven pairs of setae. Three pairs of setae which

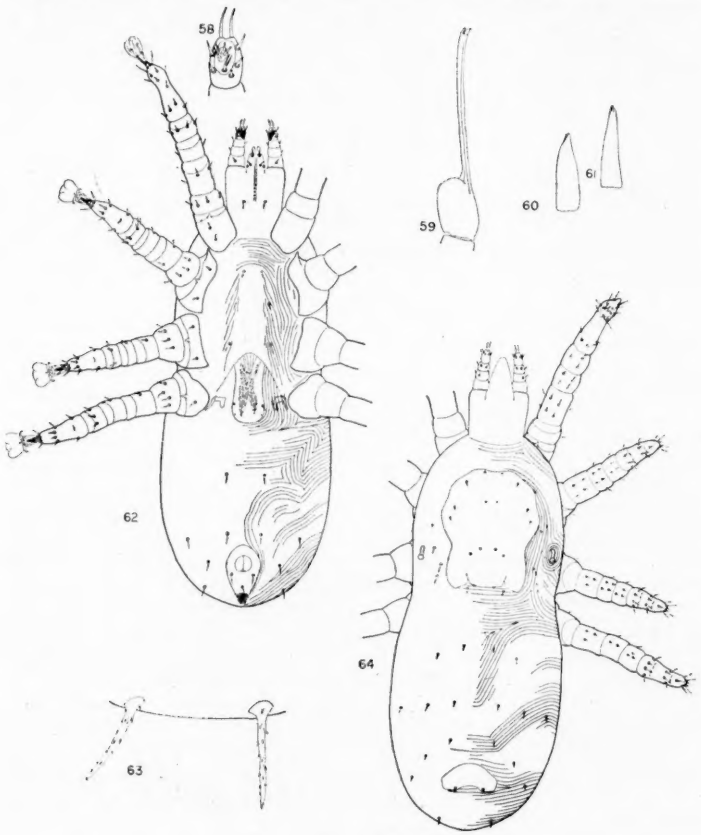


PLATE X

P. richmondenae: Fig. 58, ventral view of female palp tibia and tarsus; Fig. 59, chelicera of female; Fig. 60, chelicera of larva; Fig. 61, chelicera of deutonymph; Fig. 62, ventral view of female; Fig. 63, pygidial setae of deutonymph; Fig. 64, dorsal view of female.

are located near the anterolateral margins are moderately long and slightly pointed, the other four pairs are minute and blunt. The podosomal plate is flanked by four pairs of setae which are arranged in an uneven row along each side of the plate. A pair of setae is located posterior to the plate. The nine pairs of setae which are located on the dorsum of the opisthosoma are moderately long, slender and blunt. The pygidial plate is crescent-shaped.

MALE. Unknown.

IMMATURE FORMS (Figs. 60, 61, 63). The larva and protonymph are unknown. On the deutonymph, a pygidial plate is not present, but there are two long sparsely pilose pygidial setae.

Host and locality. Cardinals *(Richmondena cardinalis)* collected near Liberty Hill, Texas, July, 1951, and in Leon Co., Texas, March 12, 1950, by R. D. Strandtmann. Two females from two cardinals, one collected by H. B. Morlan on February 22, 1951 in Grady Co., Georgia and the other by E. K. Kardos on January 26, 1951, in Jefferson Co., Kansas.

Types. The mite was described from the holotype female, 12 paratype females and two paratype deutonymphs.

Remarks. The unusually large anal opening, the location of the three slender and sharply pointed setae posterior to the anal opening, the five setae on the venter of the opisthosoma and the three pairs of slightly pointed setae on the anterolateral margin of the podosomal plate are the characters which distinguish this species.

Ptilonyssus sairae Castro

Figs. 65-76

Castro, 1948:260; Pereira and Castro, 1949:219; Zumpt and Till, 1955: 89; Fain, 1956a:144; Fain, 1957b:102.

FEMALE (Figs. 65-70). Length of idiosoma, 644 (550-710); width, 269 (240-310). Length of podosomal plate, 195 (190-210); width, 164 (140-180). Length of anal plate, 95 (86-106); width, 61 (53-70). Length of genital plate, 120 (108-127); width, 59 (50-70).

Four pores are associated with the first two pairs of sternal setae. The six pairs of setae which are present on the venter of the opisthosoma are slender and sharp pointed. The three setae which are located on the anal plate are very similar to the ones on the venter of the opisthosoma. The paired anal setae are situated even with the anterior margin of the large, round anal opening and the unpaired seta is located posterior to the anal opening. Dorsally, nine pairs of minute setae are borne on the weakly sclerotized podosomal plate. Five pairs of acuminate setae flank the plate and a single pair is present posterior to it. Eight pairs of slender setae are borne on the dorsum of the opisthosoma. The pygidial plate is elliptic. The setal plates of the two posterior setae of genu III are enlarged to about twice the diameter of the remainder of the setal plates.

MALE (Figs. 72, 74). There are no pores associated with the first two pairs of sternal setae. On the dorsum of the opisthosoma there is a single weakly sclerotized plate which is 20μ long and 13μ wide. Five pairs of setae are located on or very near the plate. Two pairs of medium sized, acuminate setae flank the plate.

IMMATURE FORMS (Figs. 71, 73, 75, 76). The pygidial plate of the protonymph is similar to the female's except that its median anterior margin is more convex. The pygidial setae are long and sparsely pilose. A pygidial plate does not occur on the deutonymph, but two long pilose setae are present.

Host and locality. Sixty-four females, five males, one protonymph and one deutonymph were taken from lark buntings *(Calamospiza melanocorys)* collected by R. W. Strandtmann February 27, 1957, in Lubbock Co., Texas, and by D. A. Crossley, October 4, 1950, in Garza Co., Texas.

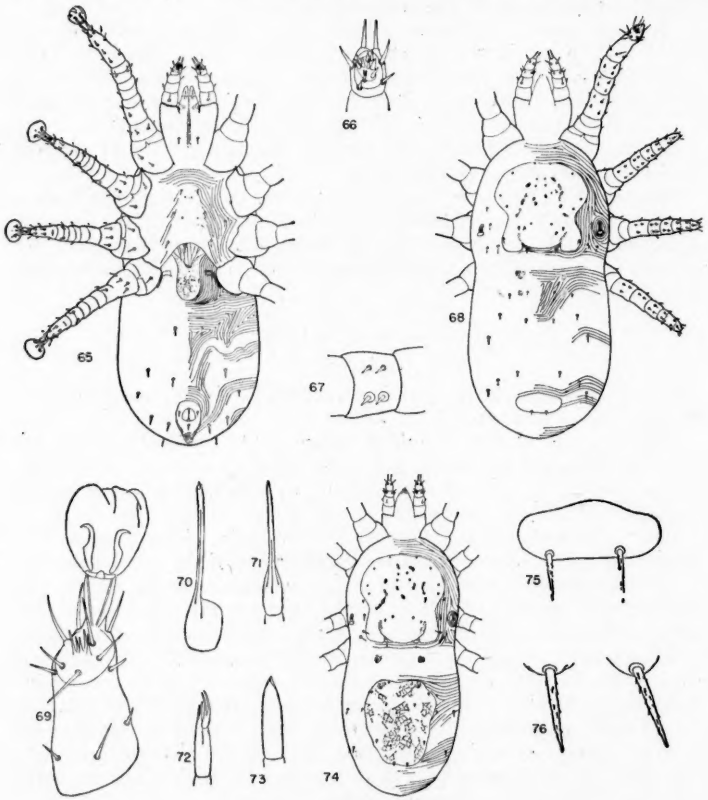


PLATE XI

P. sairae: Fig. 65, ventral view of female; Fig. 66, ventral view of female palp tibia and tarsus; Fig. 67, dorsal view of genu III; Fig. 68, dorsal view of female; Fig. 69, dorsal view of tarsus I; Fig. 70, chelicera of female; Fig. 71, chelicera of protonymph; Fig. 72, chelicera of male; Fig. 73, chelicera of deutonymph; Fig. 74, dorsal view of male; Fig. 75, pygidial plate of protonymph; Fig. 76, pygidial plate of deutonymph.

Three females from an indigo bunting *(Passerina cyanea)* collected by D. L. Brooks, May 10, 1959, in Lamb Co., Texas. Seven females and three protonymphs from brown towhees *(Pipilo fuscus)* collected by H. B. Morlan, January 17, 1952, near Santa Fe, New Mexico. Five females, two protonymphs and one deutonymph from spotted towhees *(Pipilo erythrophthalmus)* collected by H. B. Morlan, October 10, 1950, in Grady Co., Georgia, and by R. Elbel, May 5, 1951, near Thomasville, Georgia. Seven females, one male and one protonymph from vesper sparrows *(Pooecetes gramineus)* collected by R. W. Strandtmann, November 19, 1950, near Seminole, Texas; by R. O. Albert December 25, 1950 near Alice, Texas; and by D. L. Brooks, January 29, 1958, in Lamb Co., Texas. Ten females from lark sparrows *(Chondestes grammacus)* collected by R. O. Albert, October 12, 1950, near San Diego, Texas. Two females from chipping sparrows *(Spizella passerina)* both collected by R. W. Strandtmann, one June 15, 1952, in British Columbia and the other December 30, 1952, near Liberty Hill, Texas. Two females from a black-throated sparrow *(Amphispiza bilineata)* collected by R. O. Albert, October 12, 1950, near San Diego, Texas. One female and one protonymph from a Lincoln's sparrow *(Melospiza lincolnii)* collected by D. L. Brooks, April 26, 1959, in Lamb Co., Texas. One female from a savannah sparrow *(Passerculus sandwichensis)* collected by O. E. Hunt, March 1, 1950, in Leon Co., Texas. The type host is *Tangara seledon* collected in Brazil.

Remarks. The morphological characters which differentiate this mite from the other members of the genus are the presence of six pairs of slender, acuminate setae on the venter of the opisthosoma; the location of the paired anal setae even with the anterior margin of the large, round anal opening and the unpaired seta posterior to the opening; the uniform size of the nine pairs of minute setae borne by the podosomal plate.

There was no great variation in mites from the different hosts. The mites from the towhees and the vesper sparrows exhibit the most marked variations. In mites from these two birds, four setae flank the podosomal plate and a pair of long setae is located on the posterolateral edge of the plate. From the remainder of the species of birds, excepting the lark sparrow, the mites do not have the pair of long setae on the posodomal plate, but have five pairs flanking the plate. In the lark sparrow the mite has only four pairs flanking the plate.

Ptilonyssus japuibensis Castro

Figs. 77-82

Castro, 1948:264; Pereira and Castro, 1949:219; Zumpt and Till, 1955: 89; Fain, 1957b:103.

FEMALE (Figs. 77, 78, 80-82). Length of idiosoma, 680 (530-780); width, 262 (220-320). Length of podosoma, 193 (180-220); width, 150 (130-170). Length of pygidial plate, 42 (36-50); width, 72 (62-91). Length of anal plate, 99 (91-113); width, 66 (60-77). Length of genital plate, 118 (110-125); width, 48 (41-55).

Four pores are associated with the first two pairs of sternal setae. The genital setae may be located on the posterolateral margins of the plate or

just off the edge of it. A pair of pores are situated off the genital plate lateral to the setae. Three slender, acuminate setae are borne on the pear-shaped anal plate. The paired anal setae are placed opposite the anterior margin of the anal opening and the unpaired seta is located posterior to the pore. The seven pairs of setae which are borne on the venter of the opisthosoma are slender and acuminate. The podosomal plate bears eight pairs of setae. Four pairs which are located medially are minute; the remaining pairs are of medium size and are located near the lateral edges of the podosomal plate. Five pairs of pointed setae flank the plate. Two of the setae are a great deal larger than the others and are situated obliquely from the posterolateral margin of the plate. A pair of setae are borne posterior to the podosomal plate. The eight pairs of setae on the dorsum of the opisthosoma are slender and pointed. Three pairs of these setae are located laterally and are longer and larger than the other five pairs. The pygidial plate is elliptic in shape. The setal plates of the two posterior setae on the dorsum of genu III are enlarged to approximately twice the diameter of the other setal plates.

MALE (Fig. 79). Dorsally a large opisthosomal plate (204μ long and 120μ wide) is present. The poor condition of the three available males prevented examination of their morphological details.

IMMATURE FORMS. The only specimen is a deutonymph which is badly folded. A pygidial plate is absent, but long, sparsely pilose setae are present.

Host and locality. Three females from a black and white warbler *(Mniotilta varia)* collected March 26, 1951, by D. A. Crossley near Kingsville, Texas. Two females from a MacGillivray's warbler *(Oporornis tolmiei)* collected April 27, 1952, by R. O. Albert near San Diego, California. Two females from a pine warbler *(Dendroica pinus)* collected by R. Komarek and R. Elbel, November 12, 1950, in Grady Co., Georgia. Five females from a hooded warbler *(Wilsonia citrina)* collected by R. W. Strandtmann, September 25, 1948, near Galveston, Texas. Seven females and a male from pileolated warblers *(Wilsonia pusilla)* collected by D. L. Brooks, June 10, 1959, in Lamb Co., Texas. Three females from an Audubon warbler *(Dendroica auduboni)* collected by D. L. Brooks, June 5, 1959, in Lamb Co., Texas. Six females and two males from a myrtle warbler *(Dendroica coronata)* collected by Ted Tibbets, December 12, 1952, near Camp Lejeune, North Carolina. The type hosts are *Rhamphocelus carbo centralis* and *Rhamphocelus bresilius* collected in Brazil.

Remarks. This mite is distinguished from other species by the four pairs of medium-sized and four pairs of minute setae on the podosomal plate; the pygidial plate 20% more narrow on the average than the same plate on *P. sairae* which, morphologically, is the most closely related species; the enlarged pairs of setae on the dorsum of the opisthosoma.

SUMMARY

Including the seven new species described in this paper, 32 species of the genus *Ptilonyssus sensu strictu* have been described from different localities over the world. Twelve of these species have been recovered from

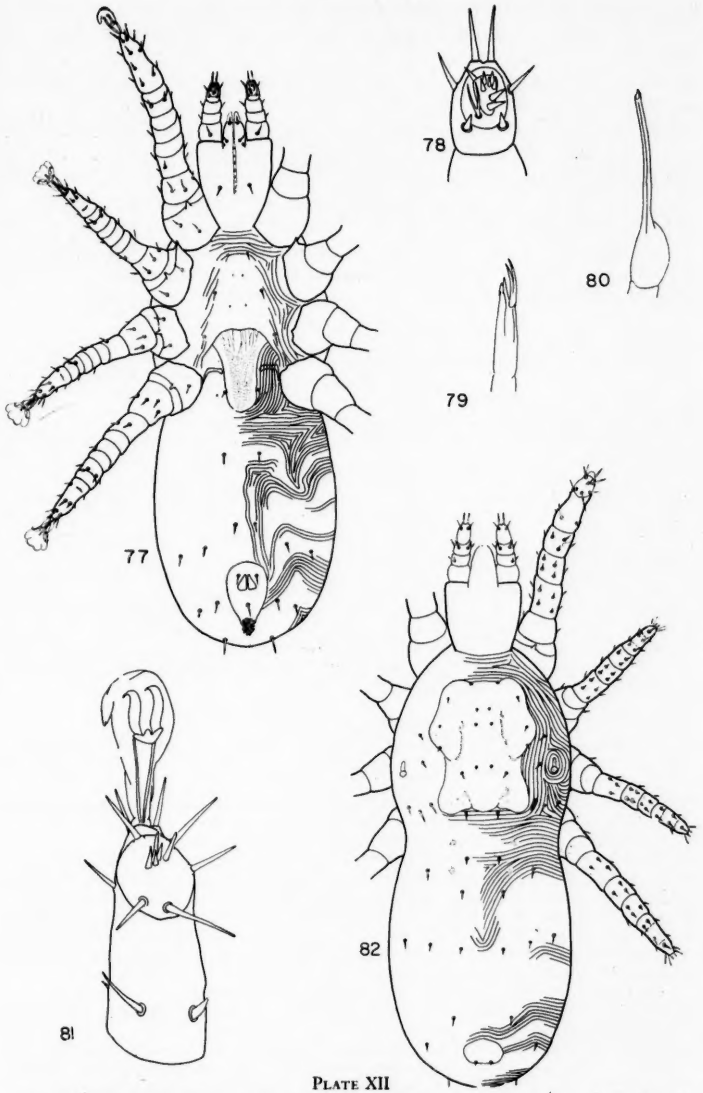


PLATE XII

P. japuibensis: Fig. 77, ventral view of female: Fig. 78, ventral view of female palp tibia and tarsus; Fig. 79, chelicera of male; Fig. 80, chelicera of female; Fig. 81, dorsal view of tarsus I; Fig. 82, dorsal view of female.

birds native to North America. The new species and their type hosts are: *P. perisorei, Perisoreus canadensis; P. tachycinetae, Tachycineta bicolor; P. salpinctis, Salpinctes obsoletus; P. mimi, Mimus polyglottos; P. phainopeplae, Phainopepla nitens; P. sialiae, Sialia currucoides; P. richmondenae, Richmondena cardinalis.* The type hosts of the old species are *P. nudus, Passer domesticus; P. sairae, Tangara seledon; P. japuibensis, Rhamphocelus carbo centralis; P. lanii, Lanius collaris; P. echinatus, Hirundo rustica.* Eleven families are represented in the 27 species of host birds. Five of the families of birds are represented by two or more species and two of the five, Parulidae and Fringillidae, are repersented by seven and nine species respectively. There have not been enough mites collected from representatives of the various passeriform families to determine anything definite relative to host specificity.

TABLE I. Passeriform Hosts of the North American Species of the Genus *Ptilonyssus*

CORVIDAE. *Cyanocitta stelleri, Perisoreus canadensis: P. perisorei.*
HIRUDINIDAE. *Hirundo rustica, Petrochlidon pyrrhonota: P. echinatus. Tachycineta bicolor: P. tachycinetae.*
TROGLODYTIDAE. *Salpinctes obsoletus: P. salpinctis.*
MIMIDAE. *Mimus polyglottos: P. mimi.*
PTILOGONATIDAE. *Phainopepla nitens: P. phainopeplae.*
TURDIDAE. *Sialia currucoides: P. sialiae.*
LANIIDAE. *Lanius ludovicianus: P. lanii.*
PARULIDAE. *Dendroica auduboni, Dendroica coronata, Dendroica pinus, Mniotilta varia, Oporornis tolmiei, Wilsonia citrina, Wilsonia pusilla: P. japuibensis.*
THRAUPIDAE. *Passerina cyanea: P. sairae. Richmondena cardinalis: P. richmondenae.*
PLOCEIDAE. *Passer domesticus: P. nudus.*
FRINGILLIDAE. *Amphispiza bilineata, Calamospiza melanocorys, Chondestes grammacus, Melospiza lincolnii, Passerculus sandwichensis, Pipilo erythrophthalmus, Pipilo fuscus, Pooecetes gramineus, Spizella passerina: P. sairae.*

TABLE II. Mites of the Genus *Ptilonyssus sensu strictu*, with Locality and Hosts.

P. andropadi Fain, 1956; RUANDA-URUNDI; *Andropadus latirostris eugenius, Pryllastrephus fischeri sucosus.*
P. aureliani Fain, 1956; RUANDA-URUNDI; *Prinia subflava graueri.*
P. chlorocichlae Fain, 1956; RUANDA-URUNDI; *Chlorocichla flavicollis pallidigula.*
P. cisticolarum Fain, 1959; SOUTH AFRICA; *Apalis flavida caniceps, Cisticola erythrips sylvia, Cisticola fulvicapilla, Cisticola robusta nuchalis, Prinia leucopogon.*
P. echinatus Berlese and Trouessart, 1889; EUROPE, SOUTH AFRICA, RUANDA-URUNDI, UNITED STATES; *Hirundo rustica:* UNITED STATES; *Petrochelidon pyrrhonota:* SOUTH AFRICA; *Petrochelidon spilodera:* RUANDA-URUNDI; *Cecropis senegalensis saturatior, Hirundo smithi.*
P. estrildicola Fain, 1959; RUANDA-URUNDI; *Lagonosticta rhodopareia.*
P. fringillicola Fain, 1959; RUANDA-URUNDI; *Emberiza flaviventris, Poliospiza striolata kivuensis, Serinus atrogularis.*
P. japuibensis Castro, 1948; BRAZIL; *Rhamphocelus bresilius dorsalis, Rhaomphocelus carbo centralis:* UNITED STATES; *Mniotilta varia, Wilsonia citrina, Wilsonia pusilla, Dendroica auduboni, Oporornis tolmiei, Dendroica pinus. Dendroica coronata.*
P. lanii Zumpt and Till, 1955; SOUTH AFRICA; *Lanius collaris humeralis:* RUANDA-URUNDI; *Calandrella cinerea saturatior, Compephaga phoenica flava, Cossypha heuglini, Geokichla piaggiae, Hypochera funerea nigerrina, Lagonosticta rhodopareia,*

Lanius collaris, Lanius collurio, Lanius excubitorius bohmi, Lanius mackinnoni, Poliospiza striolata kivyensis, Vidua macroura, Urolestes melanoleucus: UNITED STATES; *Lanius ludovicianus.*

P. mimi n. sp.; UNITED STATES; *Mimus polyglottos.*

P. motacillae Fain, 1956; RUANDA-URUNDI; *Cercomela familiaris modesta, Erythropygia coryphaeus, Motacilla aquimp vidua, Motacilla capensis weilsi, Motacilla flava, Muscicapa aquatica ruandae, Muscicapa striata, Oenanthe oenanthe, Saxicola rubetra.*

P. nicatoris Fain, 1958; BELGIAN CONGO; *Nicator chloris.*

P. nudus Berlese and Trouessart, 1889; UNITED STATES, EUROPE; *Passer domesticus:* SOUTH AFRICA; *Passer griseus.*

P, olaioi Pereira and Castro ,1949; BRAZIL; *Ampellion cucullatus.*

P. orioli Fain, 1956; RUANDA-URUNDI; *Oriolus larvatus angolensis, Oriolus oriolus.*

P. paranensis Castro, 1948; BRAZIL; *Elaenia flavogaster.*

P. perisorei, n. sp.; UNITED STATES; *Cyanocitta stelleri, Perisoreus canadensis.*

P. phyllastrephi Zumpt and Till, 1955; SOUTH AFRICA; *Phyllastrephus terrestris.*

P. psalidoprocnei Fain, 1956; RUANDA-URUNDI; *Psalidoprocne albiceps, Psalidoprocne holomelaena ruwenzorii.*

P. pycnonoti Fain, 1956; RUANDA-URUNDI; *Pycnonotus barbatus tricolor.*

P. rabelloi Castro, 1948; BRAZIL; *Sittasomus griseicapillus sylveillus.*

P. richmondenae, n. sp.; UNITED STATES; *Richmondena cardinalis.*

P. ruandae Fain, 1956; RUANDA-URUNDI; *Zosterops senegalensis.*

P. sairae Castro, 1948; BRAZIL; *Tangara seledon:* BRITISH COLUMBIA; *Spizella passerina:* UNITED STATES; *Amphispiza bilineata, Calamospiza melanocorys, Chondestes grammacus, Melospiza lincolnii, Passerculus sandwichensis, Passerina cyanea, Pipilo erythrophthalmus, Pipilo fuscus, Pooecetes gramineus.*

P. salpinctis, n. sp.; UNITED STATES; *Salpinctes obsoletus.*

P. sialiae, n. sp.; UNITED STATES; *Sialia currucoides.*

P. stresemanni Vitzthum, 1935; BRAZIL; *Procnais alba.*

P. tachycinetae, n. sp.; UNITED STATES; *Tachycineta bicolor.*

P. tersiphonei Fain, 1956; RUANDA-URUNDI; *Terpsiphone viridis kivuensis, Trochocercus cyanomelas.*

P. tillae Fain, 1959; SOUTH AFRICA; *Lamprotornis australis, Lamprotornis chalybaeus, Lamprotornis mevesii.*

P. trouessarti Hirst, 1921; AUSTRALIA; *Sphecotheres maxillaris.*

P. viduae Fain, 1956; RUANDA-URUNDI; *Vidua macroura.*

P. walterberghi Fain, 1958; BELGIUM (Zoo of Antwerp); *Suthora webbiana.*

LITERATURE CITED

Berlese, A., and Trouessart, E. L. 1889 Diagnoses d'acariens nouveaux ou peu connus. Bull. Biblioth. Sci. Ouest. 2. an., 2pt. (9), pp. 8-10.

Castro, M. P. de. 1948 Reestruturacão genérica da familia: "Rhinonyssidae Vitzthum 1935" (Acari Mesostigmata: Gamasides) e descricão de algumas espécies novas. Arg. Inst. Biol., São Paulo, 18:260-268.

Fain, A. 1956. Les acariens de la famille Rhinonyssidae Vitzthum 1935 parasites de fosses nasales des oiseaux au Ruanda-Urundi. Rev. Zool. Bot. Afr. 53:135-149.

——— 1957a. Essai de classification des Rhinonyssidae (Acari: Mesostigmata) avec description de deux genres nouveaux. Ann. Parasitol. Hum. Comp. 31:145-157.

——— 1957b. Les acariens des familles Epidermoptidae et Rhinonyssidae parasites des fosses nasales d'oiseaux au Ruanda-Urundi et au Congo Belge. Ann. Mus. Roy. Congo Belge Tervuren Ser. 8°, Zool. 60:100-121.

——— 1957c. Notes on nasal mites of birds from South Africa with description of a new species (Acarina: Rhinonyssidae). Jour. Ent. Soc. S. Africa. 20:217-222.

——— 1958a. Acariens parasites nasicoles chez les oiseaux du zoo d'Anvers description de trios especes nouvelles. Bull. de la Soc. Royale de Zool. 9:1-13.

——— 1958b. Deux nouveaux Rhinonyssides des genres Ruandanyssus et Ptilonyssus (Acarina: Mesostigmata). Rev. Zool. Bot. Afr. 57, 3-4:291-296.

——— 1959. Furthur notes on nasal mites from South Africa, with description of a new genus and five new species. Jour. Ent. Soc. S. Africa. 22(1):18-34.

Pereira, C. and Castro, M. P. de. 1949. Revisão da subfamilia "Ptilonyssinae Castro,

1948" (Acari Mesostigmata: Rhinonyssidae Vitzthum) com a descricão de algumas espécies novas. Arg. Inst. Biol. 19:217-235.
Porter, J. C. and Strandtmann, R. W. 1952. Nasal mites of the English sparrow. Texas Jour. Sci. 4:393-399.
Vitzthum, H. 1935. Milben aus der nasenhöelen von vöegeln. Jour. Ornith. 83:563-587.
Zumpt, F. and Till, W. 1955. Nasal mites of birds hitherto unknown from the Ethiopian region, with keys and descriptions of nine new species (Acarina: Laelaptidae). Jour. Ent. Soc. S. Africa. 18:69-81.

THE RELATIONSHIP OF SPIDER MITE INFESTATIONS IN COTTON TO EARLY SEASON USE OF INSECTICIDES[1]

W. P. BOYER AND ROBERT BELL[2]

Until 15 years ago, spider mites were recognized as occasional local pests of cotton. With the widespread use of the organic materials spider mite infestations have become more general and widespread. Many crops over a wide area have been involved. Hundreds of references from literature could be cited. Some of the most notable references to this problem pertain to spider mite buildup in apples following the use of chlorinated hydrocarbons, especially DDT, for the control of codling moth. Cartwright and Sutton (1949, p. 557) state that "at present the chief problem incident to the use of DDT in apple orchards is that of increased populations of the European red mite." Peterson (1946) experienced a similar situation in buildup of the European red mite following the use of DDT and BHC on apples. Baker (1952) cites several cases of mite buildup, from the use of DDT, in his review of this subject. The conference reports on Cotton Insect Research and Control (1950-59), repeatedly for the last 10 years, have referred to mite buildup in cotton following the use of the chlorinated hydrocarbons. Lincoln and Leigh (1957) state that after chlorinated hydrocarbon insecticides came into common use, mite populations frequently built to high levels, and infestations were often field-wide. In 1958 over 40 percent of the more than 4,000 fields in Arkansas being systematically checked by cotton scouts had varying degrees of mite infestation in July and early August. Many of these fields required special applications of miticides.

The importance of predaceous and parasitic insects in cotton has been recognized in Arkansas and over the Cotton Belt since research on cotton insects first started. Under normal conditions, predaceous insects usually hold populations of bollworms, spider mites, and aphids to non-economic levels. The reduction in numbers of these beneficial insects by the use of insecticides may necessitate additional applications for the control of bollworms, spider mites, and aphids.

During years of normal to heavy rainfall much of the cotton in eastern Arkansas must be treated for second and later generations of boll weevils. Infestations seldom reach economic levels until late July or early August.

[1] Published by permission of Director of Agricultural Experiment Station.

[2] W. P. Boyer is Survey Entomologist, University of Arkansas. Robert Bell is a graduate student and cotton scout.

The effect of early season insecticidal applications on spider mite infestations was studied in a large scale farming operation in Jefferson County, Arkansas, in 1958. This particular farming operation has been chosen for illustration as it includes a large number of scattered fields under a single management. Also, its insect problems and their sequence are similar to those of many others in southeast Arkansas. The data presented were taken from records obtained in the cotton insect scouting program. In this program University trained scouts make systematic weekly infestation counts and record the use of insecticides. A total of 3,700 acres of cotton in 148 fields on eight farm units, all under the same management, was involved. Thirty-six fields were put on a fixed, early season insecticide program, whether infested or not, while the other 112 fields were to be treated with insecticides only when insect abundance made it seem advisable.

The early season arbitrary program included two applications at weekly intervals beginning at the two-leaf stage, followed by three applications at weekly intervals beginning at the pin-head square stage. All applications were of chlorinated hydrocarbons. The first two applications were made, in general, the last week in May and the first week in June. The following three applications were made from mid- to late June. After this, applications were made as indicated by scouting.

Insecticidal treatments earlier than those required by late season boll weevil infestations were made in 45 of the 112 fields which were not subjected to the arbitrary early schedule. These 45 fields suffered an unusual, heavy outbreak of garden webworms in mid-June which necessitated treatment. All 45 fields were treated one time with a chlorinated hydrocarbon insecticide, applied June 18-25.

Thus, for comparison, there were three sets of treatments: 36 fields with the early fixed schedule of five applications; 45 fields with single early insecticidal application in mid-June; and 67 fields with no early treatments.

The effect of early season applications of insecticides on spider mite infestations is given in Table 1.

TABLE 1: The need of spider mite control in relation to early applications of insecticides. Jefferson County, Arkansas, 1958.

Farm No.	No. Fields	No. Fields Given Early Season Treatment	No. Fields Treated for Garden Webworm	No. Fields Given No Early Season Treatment	No. Fields Treated for Mites Following: Early Season Treatment	Garden Webworm Treatment	No Early Season Treatment
1	17	9	6	2	8	3	0
2	16	4	3	9	2	2	0
3	28	11	0	17	3	....	0
4	13	0	7	6	....	1	0
5	22	12	2	8	0	0	0
6	13	0	4	9	....	0	0
7	26	0	17	9	....	11	0
8	13	0	6	7	....	1	0
Totals	148	36	45	67	13	18	0

The need for control was based on the number of mites per leaf present and the dispersion of the infestations. In general, mite infestations are in localized spots; however, in most of these cases infestations were sufficiently widespread that entire fields were treated.

Miticide applications were made from July 10 to August 13; however, a big majority were made July 23 to July 28.

The effect of insecticidal applications in early season on building mite outbreaks was shown by the need for mite control on 13 of 36 fields receiving early automatic treatments and on 18 of 45 fields treated in June for control of garden webworm. On the other hand, not one of the 67 fields which were not treated in May or June needed treating for mites.

The question naturally arises as to why 40 per cent of the garden webworm fields, which received only single early appliçations, required mite treatment while 36 percent, a lower percentage, of the fields receiving five early applications required mite treatments. The early season applications built up heavy aphid infestations which had to be treated with special appliations. Of the 36 early season fields, 24 fields received a total of 40 applications of an organic phosphate for aphid control. These applications were all made prior to August 1. The organic phosphate used is effective against some species of mites and suppresses other species. Thus there was at least partial mite control resulting from aphid control in a majority of the fields.

LITERATURE CITED

Baker, H. 1952. Spider mites, insects, and DDT. Insects. U.S.D.A. Yearbook of Agriculture.

Cartwright, C. R., and R. Sutton. 1949. Effectiveness of acaricides in DDT-sprayed apple orchards. Jour. Econ. Ent. 40:557-561.

Conference reports on cotton insect research and control. 1950-59. Annual Reports, Ent. Research Branch, Agr. Res. Service, U.S. Department of Agriculture.

Lincoln, Charles, and T. F. Leigh. 1957. Timing Insecticide applications for cotton insect control. Arkansas Agric. Exp. Sta. Bull. 588.

Peterson, P. D. 1946. Field experiments with DDT and BHC sprays on apple and peach in 1946. Trans. Peninsula Hort. Soc. 1946:82-84.

BIOLOGICAL OBSERVATIONS ON *HEMIHALICTUS LUSTRANS*, WITH A DESCRIPTION OF THE LARVA (Hymenoptera: Halictidae)

HOWELL V. DALY
University of California, Berkeley

The purpose of this paper is to provide fragmentary information on the life history and behavior of *Hemihalictus lustrans* (Cockerell). The habits of this species have been known only from collectors' records. The monotypic *Hemihalictus* Cockerell has several distinctive anatomical characters

but is otherwise similar to *Evylaeus* Robertson (Michener, 1947; Mitchell, 1960).

Hemihalictus is unusual among halictines for its matinal oligolecty (Linsley, 1958). Both sexes are taken almost exclusively from flowers of *Pyrrhopappus* DC., a genus of Cichorieae (Compositae) containing seven or possibly eight species distributed from Delaware west to Kansas, New Mexico, southern Arizona, and northern Mexico, and south to northern Florida, southern Texas, and Mexico (L. H. Shinners, *in litt.*). The range of the bee, based on scattered records, largely agrees with the distribution of the host genus with the exception of an individual taken in southern Michigan (Michener, 1947) where *Pyrrhopappus* is not known to occur (E. G. Voss, *in litt.*). Other plants visited by *Hemihalictus* are listed by Michener (1947) and Mitchell (1960).

The notes reported below were made during the summer of 1960 in Louisiana at two localities: 1 mile east of Opelousas and 10.1 airline miles southeast of Baton Rouge. The former station was a narrow roadside strip of scattered weeds adjacent to a heavily grazed pasture, and the latter station was a thickly weeded vacant lot partly surrounded by a gentle and sparsely covered bank. The soil in both areas consisted of a clay. A search fifty miles east and west of Baton Rouge failed to reveal other areas in-

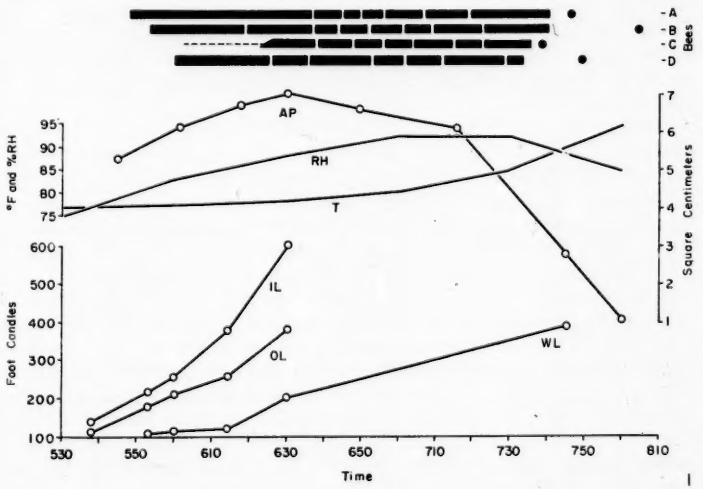


FIG. 1. Physical factors, flowering of *Pyrrhopappus*, and foraging activity of *Hemihalictus* on 27 July 1960 at Baton Rouge, Louisiana. Physical (left ordinate) and biological (right ordinate) variables plotted against time (abscissa). Light intensities: IL, incident light; OL, overhead lght; WL, western light. Temperature: T. Relative humidity: RH. Flowering of *Pyrrhopappus* indicated by average of areas of four blossoms: AP. Activity of *Hemihalictus* indicated by black bars for periods outside nests; black dots indicate times entrance plugs appeared.

habited by the bees, although patches of *Pyrrhopappus* were common along the highway.

I am indebted to Dr. Murray S. Blum and Mr. J. E. Roberts, Jr. for their help with the recording of the activity of the bees on 12 July. I also wish to thank Dr. L. D. Newsom, Head, Department of Entomology, Louisiana State University, for his support of this and other studies of wild bees in Louisiana. Special thanks are due my wife, Barbara, for her assistance with the preparation of the illustrations.

FORAGING HABITS

Both sexes of *Hemihalictus* were present in collections made from 9 June to 18 July. Although numerous other species of plants bloomed near the stations during this time, including *Lactuca canadensis* L., another member of the Cichorieae, the bees were found only on *Pyrrhopappus carolinianus* (Walt.) DC. This plant was abundant throughout the season and was also visited for pollen by females of *Agapostemon virescens* (Fabr.), *Augochlorella striata* (Prov.), *Bombus americanorum* (Fabr.), *B. griseocollis* (Degeer), *B. impatiens* Cresson, *Dialictus inconspicuus* (Smith), three other species of *Dialictus,* and *Halictus ligatus* Say.

The daily activity of *Hemihalictus* above ground is closely synchronized with the availability of pollen and nectar supplied by *Pyrrhopappus.* The factors contributing to this synchronization could not be studied adequately at this time. Figure 1 summarizes some of the important events recorded at Baton Rouge on 24 July. Substantially the same events were observed on other mornings during July at both stations.

Before dawn the heads of the plants are directed toward the east with the limp corollas loosely enclosed by the involucre. The nests of the bees are open at this time, but the females remain out of sight. The flowers begin to expand rapidly with the appearance of the sun. In less than one-half hour after sunrise the diameters of the blossoms have increased by almost half, and the pollen is exposed among the corollas. Within the span of a few minutes bees of widely separated nests leave their burrows. The first exit is made with a zigzag "orientation flight." Early foraging trips may be long because not all the blossoms visited have opened sufficiently to supply pollen. The returning bees usually enter their burrows without hesitation and return to the surface in about 45 seconds. The subsequent exits are made without a pause at the entrance and usually without another orientation flight. During the next hour the blossoms continue to expand, reaching twice the diameter of the closed heads. The flowers are open for a period associated with the duration of high relative humidity and moderate temperature. Such conditions persist after sunrise because the rate of heating lags behind the sharp rise in light intensity. Early in the season or on overcast mornings the flowers remain open later, and the bees continue to forage.

On 12 July at the Opelousas station an individual emerged from her burrow with a fireant, *Solenopsis saevissima* v. *richteri* Forel, clinging to a forewing. After the ant was removed by me, the bee was marked with

paint and released. During the next 56 minutes we followed the bee's route from flower to flower, losing her location twice, but recording her activities for 45 minutes. Blossoms of *Pyrrhopappus* were scattered in the adjacent pasture and to either side of the nest. The bee, however, repeatedly foraged over a series of six plants, each bearing several blossoms, which were situated west of the nest at distances of 3.7 to 8.5 M from the nest. After leaving the burrow she visited the nearest group of blossoms; and, moving away, she stopped at two or more of the plants further west. Then she retraced her outbound route, stopping again at blossoms she had visited a few minutes previously, and flew to the nest from the nearest plant. While the blossoms were fully opened, the stop at each lasted about 45 seconds. Later, when the heads were closing, extra time was spent working among the corollas or making unsuccessful attempts to enter several flowers before a suitable head was found. Similar records of a foraging circuit were made with a marked female on 27 July at Baton Rouge. In this case the bee was seen periodically passing through a foraging area about 12 M from her nest and repeatedly visiting the same flowers. A census of the numbers and kinds of bees on fifty-six blossoms at the roadside area (Opelousas) was made eight times in two hours on 12 July. No more than seven *Hemihalictus* of both sexes were seen at one time, and this frequency was present most of the morning. Such a uniform density might be expected to result from regular visits by bees from nearby nests. In contrast, *Agapostemon virescens, Bombus americanorum, Halictus ligatus,* and *Dialictus* spp. were scarce and irregular in the frequency of their visits to this area.

When the closure of the blossoms virtually prevents further visitation, the bees abruptly cease foraging. Shortly after the females enter their nests, the entrances are closed with several compact plugs of moist soil.

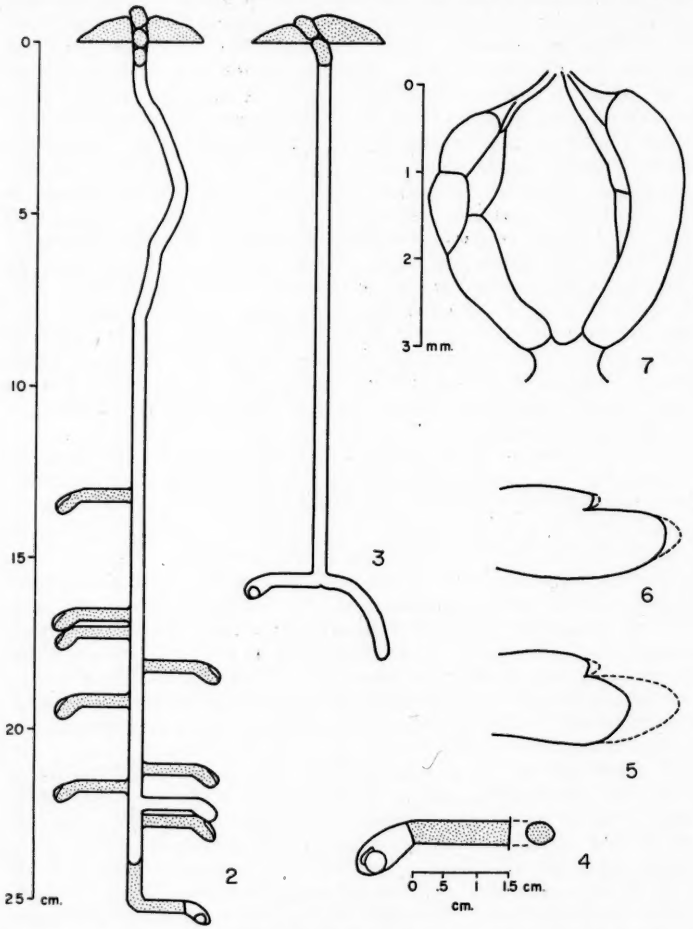
NESTING HABITS

The aggregations of nests at both stations were in areas of bare ground. At Baton Rouge twenty nests were found along about 60 M of the westward facing bank. Five nests of *Hemihalictus* and one each of *Augochlorella striata* and *Halictus ligatus* were situated within a half square meter, but the remaining nests of the first genus were scattered widely. The tumuli of nests were seen on 9 June with the discovery of the species at Opelousas. Construction of nests was still evident when the study was discontinued on 18 August at Baton Rouge.

Excavation of eight nests revealed two kinds: new nests and reused nests. This distinction is verified by comparison of the mandibles of the bees in the respective nests. The well-worn mandible (Fig. 5), associated with a new nest (Fig. 3), reflects the wear of digging the burrow. The slightly worn mandible (Fig. 6) of the bee from the nest with old cells (Fig. 2) suggests that she is not the original resident, but at least the second to construct cells off the burrow. Up to ten old cells, but no more than four fresh cells, were found in a nest. Only one bee occupied each burrow. Irrespective of the kind of nest and, consequently, the condition of the mandibles, the ovaries of each female contained only one large oocyte

(Fig. 7). Six of nine foragers lacked pollen in the crop although each had a large oocyte. These facts indicate that the species is solitary.

The main burrow of the nest, measuring 4 mm. in diameter, is unbranched, unmodified at the entrance, and almost vertical except where obstructions are encountered. The first cells are constructed at about 14 cm. and additional ones are added with increasing depth of the burrow. The



FIGS. 2-7. 2, 3, nests of *Hemihalictus lustrans* (stippling indicates soil deposited by bees); 4, detail of cell; 5, 6, mandibles of females showing wear (probable original conditions shown by broken lines); 7, ovaries of female with a large oocyte.

maximum depth recorded was 29 cm. The cell is inclined by an angle of about 30° and is connected to the vertical burrow by a horizontal tunnel which is filled with granulated soil (Fig. 4). Old cells are filled with soil and have a flattened deposit of feces on the roof near the bottom of the cavity.

LARVA

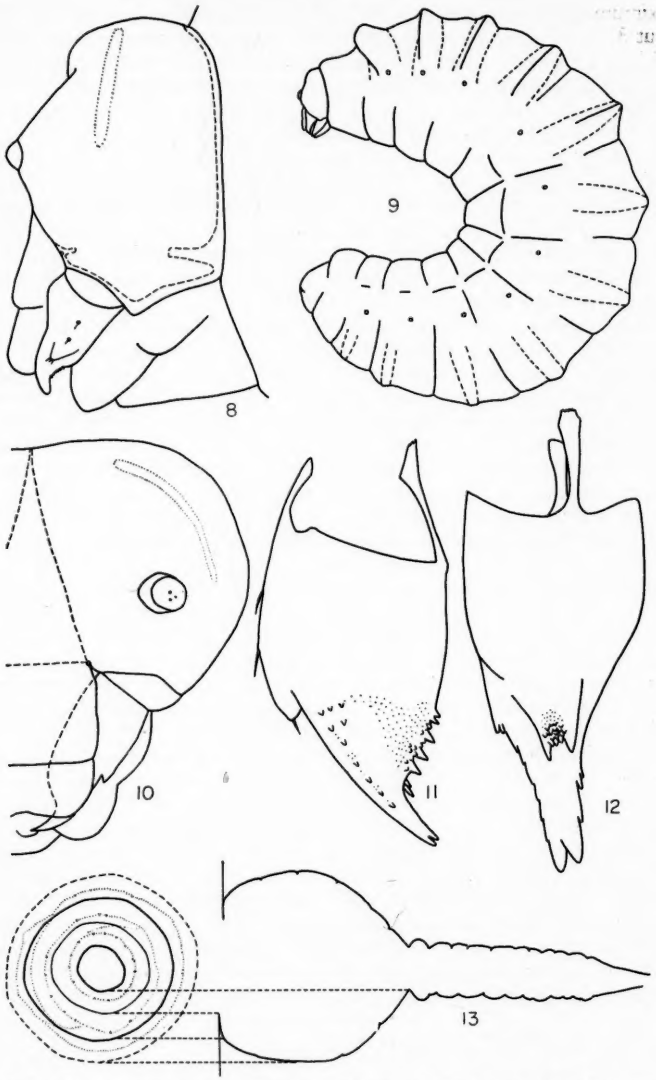
Two larvae, one mature and the other with a small amount of pollen, were found on 29 July at Baton Rouge in the nest of *Hemihalictus*. The specimens were killed and fixed in hot Kahle's solution (Guyer, 1953) and the dissected parts were cleared in hot lactophenol. The anatomical terminology used below is that of Michener (1953).

Head capsule (maximum width: 1.1 mm.) and mouthparts (Figs. 8, 10) weakly sclerotized and with sparse minute setae; anterior tentorial arms weak, posterior tentorial arms stout; posterior, hypostomal, and pleurostomal thickenings clearly evident; portions of epistomal suture lateral to anterior tentorial pits with an internal thickening which is confluent with pleurostomal thickening; median part of epistomal suture present only as a shallow, transverse depression; median thickening virtually absent; cleavage lines diverging from near summit of head, evident as shallow creases extending to anterior tentorial pits; parietal band weak; dorsal area of head above antennae swollen, limited below by a shallow triangular depression; antennae evenly convex, half as high as wide and with three minute setae at apex; labroclypeal suture present as a distinct fold; labrum broad, truncate, its slight emargination accentuated by low labral tubercles; mandible (Figs. 11, 12; length: .035 mm.) with broad base, abruptly narrowed distad to an attenuate apex which is concave on inner surface; apex of mandible with two large, subequal teeth; subapical margins dentate; inner cusp of mandible multidentate; tubercle on outer surface of mandible prominent and with three apical setae; two setae on outer surface of mandible basad of tubercle; maxilla blunt, rounded; maxillary palpus absent; line between maxilla and labium absent basally; prementum not distinctly separated from postmentum; labial palpus absent; salivary opening present as a small curved slit without projecting lips.

Body (Fig. 9; extended length: 9.5 mm.) soft, white, robust, coiled in "C" shape; abundant minute spicules in some areas; dorsolateral tubercles transverse and most prominent on thoracic segments where they extend nearly to level of spiracles; epipleural lobes evident on anterior abdominal segments; spiracle (Fig. 13) unpigmented; peritreme complete, flat; inner surface of atrium (diameter: .006 mm.) with several anastomosing ridges bearing scattered, minute spines; primary tracheal opening without collar.

CONCLUSIONS

Hemihalictus lustrans is a matinal oligolege depending primarily on species of *Pyrrhopappus* for pollen and nectar. In the vicinity of Baton Rouge, Louisiana only two aggregations of nests were located although



FIGS. 8-13. 8, mature larva of *Hemihalictus lustrans,* lateral view of head; 9, lateral view of same; 10, cephalic view of head of same; 11, 12, ventral and inner views of mandible of same; 13, spiracle of same (facial view at left, section of lateral view at right).

suitable flowers and nesting sites were common. The efficient use of the limited time available for foraging is presumably enhanced by the prompt appearance of the bees within minutes of the beginning of the flowering period, the repeated visitation of the same nearby flowers, and the uninterrupted collection and storage of provisions. *H. lustrans* is solitary in habits, but nests may be reused by different individuals. The structure of the nest and the anatomical features of the larva confirm the relationship of *Hemihalictus* with other genera of the Halictinae.

LITERATURE CITED

Guyer, M. F. 1953. Animal Micrology. 5th rev. ed. Chicago, Univ. of Chicago Press, xviii + 327 pp.

Linsley, E. G. 1958. The ecology of solitary bees. Hilgardia, 27:543-599.

Michener, C. D. 1947. Some observations on *Lasioglossum (Hemihalictus) lustrans* (Hymenoptera, Halictidae). Jour. New York Ent. Soc., 45:49-50.

———. 1953. Comparative morphological and systematic studies of bee larvae with a key to the families of hymenopterous larvae. Univ. Kansas Sci. Bull., 35:987-1102.

Mitchell, T. B. 1960. Bees of the eastern United States. Vol. I. N. Carolina Agr. Expt. Sta. Tech. Bull. No. 141, 538 pp.

SEED CLEANING AS A SOURCE OF INFESTATION FOR STORED GRAIN[1]

PHIL ROUSE AND L. H. ROLSTON[2]

Control of stored grain insects in both farm and commercial storage is often complicated by reinfestations. Cleaning of seed grain as an enterprise secondary to grain storage contributes to the problem. Seed grain is often heavily infested at the time it is cleaned. The same equipment is generally used to move both seed and stored grain, and often the cleaner is located among storage bins. Grain in storage may be reinfested by contaminated handling equipment and by insects escaping during the cleaning process or from cleaning fractions.

The screening fractions contain the undersized and broken grain. These are often sacked and taken back to the farm for feed, where occasionally they are stored with or near other grain. Under these conditions they may be an important source of infestation for grain in farm storage.

The efficiency of seed cleaning in removing stored grain insects from oats and rice was estimated by laboratory tests with a sieve-type dockage tester. The location of insects following cleaning was determined by examining each cleaning fraction, the cleaned grain, and the machine. Five levels of infestation were simulated by releasing a known number of adult insects

[1] Published with the permission of the Director of the Arkansas Agricultural Experiment Station.

[2] Research Assistant, University of Arkansas, and Associate Entomologist, University of Arkansas, respectively.

in a thousand gram sample of uninfested combine run grain. Each level of infestation was replicated four times for each insect species and grain tested.

The results of these tests are given in Tables 1 and 2, and a diagram of the essential features of the dockage tester in figure 1.

TABLE 1. Efficiency of cleaning in removing adult stored grain insects from oats and disposition of removed insects among cleaning fractions.

Insects in Uncleaned Sample	Percentage of Insects By Location After Cleaning						
	Top Suction	First Scalp	Second Scalp	Clean Grain	Bottom Pan	Recovered In Tester	Escaped
				Rice Weevils			
5	5.0	0	5.0	0	65.0	5.0	20.0
25	7.0	0	3.0	2.0	69.0	0	19.0
100	10.8	0.2	0.8	0	83.5	0	4.7
250	12.0	0.1	1.9	0.3	79.8	0	5.9
1000	10.2	0.2	1.8	0.7	80.0	0.7	6.4
				Lesser Grain Borer			
5	5.0	0	0	0	80.0	0	15.0
25	8.0	0	1.0	0	88.0	0	3.0
100	10.0	0	0.5	0.2	84.2	0.2	4.9
250	13.3	0.1	0	0.1	83.8	0	2.7
1000	11.9	0	0.2	0.1	82.0	0	5.8
				Saw-Toothed Grain Beetle			
5	50.0	0	0	0	15.0	0	35.0
25	68.0	0	1.0	0	23.0	0	8.0
100	64.8	0	0.5	0	24.8	1.2	8.7
250	61.8	0	0.5	0	31.9	0.6	5.2
1000	63.5	0.02	0.2	0.8	28.8	0.2	6.5
				Red Flour Beetle			
5	10.0	0	0	0	85.0	5.0	0
25	7.0	0	1.0	1.0	87.0	0	4.0
100	7.2	0	2.2	1.0	82.8	3.5	3.3
250	7.5	0.1	2.1	0.7	87.7	0.4	1.5
1000	5.6	0.5	1.2	2.1	89.2	0.2	1.2

Cleaning removed a high percentage of stored grain insects from the grain. Most of these were aspirated into the top suction chamber or fell through the sieves into the bottom pan fraction. Very few insects were recovered in the scalpings but an appreciable percentage remained in the machine or escaped entirely. The efficiency of the cleaning process in removing stored grain insects and the disposition of the insects among the cleaning fractions were determined largely by the grain and insect species. The amount of suction used in commercial cleaning will no doubt be another important variable. Under uniform cleaning procedures, and for a given grain and insect species, efficiency and disposition were generally unaffected by the number of insects in the uncleaned sample.

Cleaning was much more effective in removing adult insects from oats than from rice. The saw-tooth grain beetle, *Oryzaephilus surinamensis* (L.) was most readily removed by cleaning, following by the lesser grain borer, *Rhyzopertha dominica* (F.), the rice weevils, *Sitophilus* spp., and the red flour beetle, *Tribolium castaneum* (Herbst), in that order. The lesser grain

borer would undoubtedly be more difficult to remove from established infestations.

Six lots of infested oats and barley seed were examined for stored grain insects before and after cleaning at four commercial establishments. The various cleaning fractions were examined after each lot of grain was run. Cleaning removed most of the stored grain insects present, although stages developing within kernels were not removed. The disposition of the insects removed by cleaning was similar to that obtained with the laboratory dockage tester. All cleaning fractions were infested but the heaviest infestations were in the top blower and screening fractions (Table 3).

Insects were observed to escape from the cleaner during the cleaning process. Where the cleaner is locatd in the same building as storage bins, these escapees constitute no small source of infestation. It is apparent that

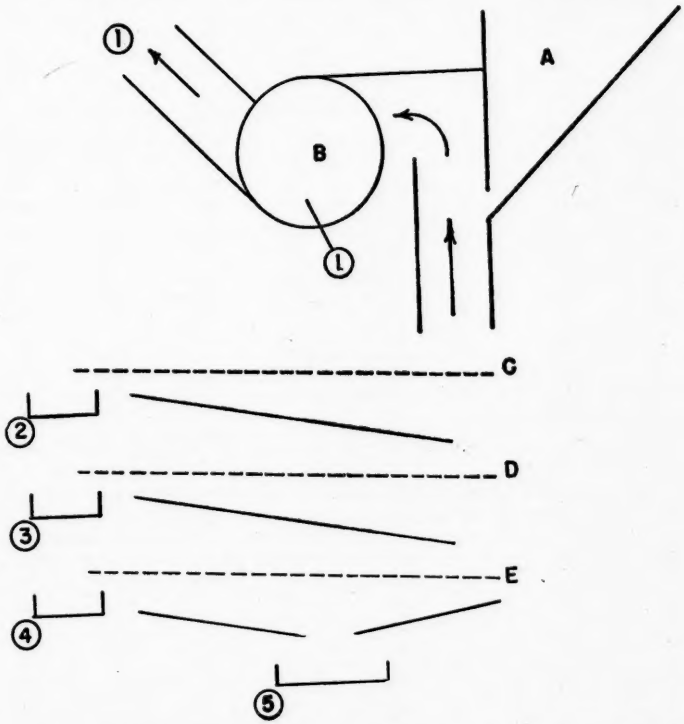


FIG. 1. Essential features of dockage tester and location of cleaning fractions. Dockage Tester Parts: A. Hopper; B. Blower; C. First Sieve; D. Second Sieve; E. Third Sieve. Cleaning Fractions: 1. Top Suction; 2. First Scalp; 3. Second Scalp; 4. Cleaned Grain; 5. Bottom Pan (Screenings).

cleaners should be isolated from storage bins and should have separate grain handling facilities. Where this can not be arranged, cleaning fractions should be promptly removed or heavily fumigated and residual sprays used liberally.

Screening fractions taken to the farm for feed should be isolated from stored grain or heavily fumigated.

TABLE 2. Efficiency of cleaning in removing adult stored grain insects from rice and disposition of removed insects among cleaning fractions.

Insects in Uncleaned Sample	Percentage of Insects By Location After Cleaning						
	Top Suction	First Scalp	Second Scalp	Clean Grain	Bottom Pan	Recovered In Tester	Escaped
				Rice Weevils			
5	20.0	0	0	0	65.0	0	15.0
25	8.0	1.0	1.0	20.0	62.0	1.0	7.0
100	18.5	0	0	16.2	60.8	1.2	3.2
250	15.6	0	0	16.5	67.7	0	0.2
1000	15.7	0	0	22.1	60.0	1.3	0.9
				Lesser Grain Borer			
5	45.0	0	0	0	55.0	0	0
25	32.0	0	0	9.0	58.0	0	1.0
100	21.0	0	0	9.7	66.7	1.7	1.0
250	24.4	0	0	13.8	57.9	4.0	0.3
1000	29.6	0	0	7.6	60.9	1.3	0.6
				Saw-Toothed Grain Beetle			
5	55.0	0	0	0	25.0	20.0	0
25	64.0	0	0	3.0	18.0	1.0	14.0
100	66.2	0	0	4.8	24.5	0.8	3.8
250	70.3	0	0	4.6	15.0	6.0	3.8
1000	73.9	0	0	0.7	7.3	9.7	8.4
				Red Flour Beetle			
5	5.0	0	0	25.0	50.0	10.0	10.0
25	12.0	0	0	45.0	35.0	6.0	2.0
100	16.2	0	0	36.2	39.5	5.0	3.0
250	15.0	0.1	0.1	33.8	43.8	5.6	1.1
1000	19.8	0	0	2.5	72.7	3.2	1.7

TABLE 3. Number of insects per gallon in oats or barley before and after commercial cleaning and in the cleaning fractions.

Lot No.	Before Cleaning	1st & 2nd Scalpings	Top Blower	Bottom Blower	1st & 2nd Screenings	Dust Collector	Cleaned Grain
1	9	1	226	7	35	....	0
2	6	4	18	....	0	2	0
3	20	....	344	....	12	4	0
4	....	1	4	....	11	....	0
5	12	....	278	6	81	....	0
6	5	0	282	3	41	....	1

NEW SPECIES AND TAXONOMIC CHANGES IN THE TINGIDAE (Hemiptera)

CARL J. DRAKE AND FLORENCE A. RUHOFF
Smithsonian Institution

The present paper includes the descriptions of two new tingids from northern Africa and makes many taxonomic changes, generic and specific, worldwide in scope. Holotypes of the new species are deposited in the Museum National d'Histoire Naturelle, Paris, France.

Through the cooperation of Dr. J. Carayon of the above museum, we have been able to study some material collected by him in the Sahara and paratypes of species described by Bergevin from Algeria. The illustrations were drawn by Patricia J. Hogue, Arlington, Virginia. This study was made possible by means of grant 4095, National Science Foundation.

NEW COMBINATIONS

The species bearing specific names as follows are here transferred from their present nominal genera to other genera as indicated: *Physatocheila gibbula* Horváth (1912) to the genus *Cysteochila; P. monostrosa* (Scott) (1874) to *Cysteochila; P. josephinae* Schouteden (1923) to *Cysteochila; Oncophysa nitens* Drake and Poor (emend.) (1937) to *Cysteochila; Furcilliger comptus* Drake (1942) to *Lasiacantha; Cromerus bimaculata* (Distant) (1909) to *Perissonemia; Cysteochila bullana* Drake (1958) to *Naochila; Leptopharsa albocosta* (Drake) (1922) to *Corycera;* and *Compseuta elegantula* (Distant) (1909) to *Hegesidemus.*

NEW SYNONYMS

The species given the following specific names are here relegated into synonymy: *Ammianus amoenus* Drake (1956) is suppressed as a synonym of *A. mussolinii* (Mancini) (1939); *Monanthia zavattarii* Mancini (1953) as a synonym of *Dictyla nodipennis* (Horváth) (1910); *Sphaerocysta romani* Drake (1947) as a synonym of *S. paris* Drake (1939); *Compseuta kittenbergeri* Drake (1951) as a synonym of *C. bispinosa* Drake (1951); and *Corythucha globulifera* Monte (1940) as a synonym of *C. globigera* Breddin (1901); *Physatocheila chanceli* Bergevin (1919) as a synonym of *P. delicatula* Horváth (1903).

Physatocheila irregularis Montrouzier

Fig. 1.

Physatocheila irregularis Montrouzier, 1861, Ann. Soc. Ent. France, p. 68.—Lethierry and Severin, 1896, Cat. Gén. Hém. Hét., vol. 3, p. 26 (species wrongly assigned to Montrouzier and Signoret).

Only one specimen of *P. irregularis* from Lifu, Loyalty Islands, is in the Montrouzier Collection, Naturhistorisches Museum, Vienna, Austria. This specimen is a macropterous male, mounted on a rectangular card and is in

an almost perfect state of preservation. The pin bears the labels: (1) *"Coreus irregularis (Mihi), Lifu"* in Montrouzier's handwriting, and (2) two other labels *"Lifu"* and *"irregularis coll. Signoret."* According to footnotes (Montrouzier, 1861, pp. 59, 68) Dr. Signoret kindly checked the classification and descriptions, including types of new species, of the Hemiptera collected by Father Montrouzier in New Caledonia. As there is only one specimen of *irregularis* in the above museum, it is the holotype. The following notes are based upon this, the type specimen (Fig. 1):

Small, oblong, grayish testaceous, with pronotum brownish and brownish fuscous band across elytra behind apex of pronotal process. Antenna slender, pale testaceous, with first two segments brownish and fourth segment fuscous, segmental measurements: I, 0.09 mm.; II, 0.08 mm.; III, 0.65 mm.; IV, 0.20 mm. Pronotum moderately convex, punctate, tricarinate, each carina composed of one row of tiny areolae, the lateral pair divergent anteriorly; paranota narrow, erect, composed of one row of small areolae. Elytra with sutural areas overlapping in repose; costal area composed of two rows of small areolae; subcostal area biseriate, turned obliquely downward; discoidal area large, extending beyond middle of elytron, on same horizontal level as the sutural area. Length 2.40 mm., width 0.95 mm.

This species is known only from the holotype, Lifu. The paranota are much more narrow than in most species of the genus *Physatocheila* Fieber. There are several members of this genus from the Australian and Oriental regions with narrow paranota, but *irregularis* is the only one that has the paranota erect and not completely reflexed so as to rest upon the pronotum.

Cysteochila poecilia, n. sp.

Fig. 2

Small, oblong. Testaceous to slightly brownish testaceous, with pronotum, posterior part of paranota at humeri, head, and the very wide, transverse band of elytra dark reddish fuscous; body beneath brown, with laminae of buccal and rostral sulcus of pronotal sterna testaceous. Antennae testaceous, with basal two segments brown and fourth segment fuscous. Legs testaceous, with femora slightly embrowned, tips of tarsi slightly dusky. Length 3.00 mm., width (elytra) 0.72 mm.

Head very short, armed with five brownish or testaceous spines; occipital pair long, appressed, median and frontal pair shorter, porrect; bucculae wide, ends meeting in front, areolate. Labium brownish testaceous, with apex fuscous, not reaching middle of mesosternum; sternal laminae of rostral sulcus wide, uniseriate, slightly converging posteriorly, more widely separated and cordate on metasternum, with a wide, V-shaped opening behind. Hypocostal lamina fairly wide, uniseriate. Ostiole and ostiolar canal of metathoracic scent glands very distinct on each metapleuron, the sulcus nearly upright, slightly curved backwards. Antenna indistinctly pubescent, segmental measurements: I, 0.10 mm.; II, 0.09 mm.; III, 0.58 mm.; IV, 0.21 mm.

Pronotum moderately convex, distinctly punctate, tricarinate; median carina distinctly more elevated than lateral pair, composed of one row of small areolae; lateral carinae without areolae, distinctly diverging anteriorly,

covered in front of pronotal disc by reflexed paranota; collar testaceous, elevated so as to form a tectiform hood, obtusely angulately projecting in front; paranota fairly wide, reflexed, slightly elevated and prominent at humeral angles. Elytra with apices overlapping at rest, with divisions separated from one another by fairly prominent boundary veins; subcostal area very narrow, uniseriate; subcostal area sloping obliquely downward, biseriate; discoidal area large, extending beyond middle of elytra, outer

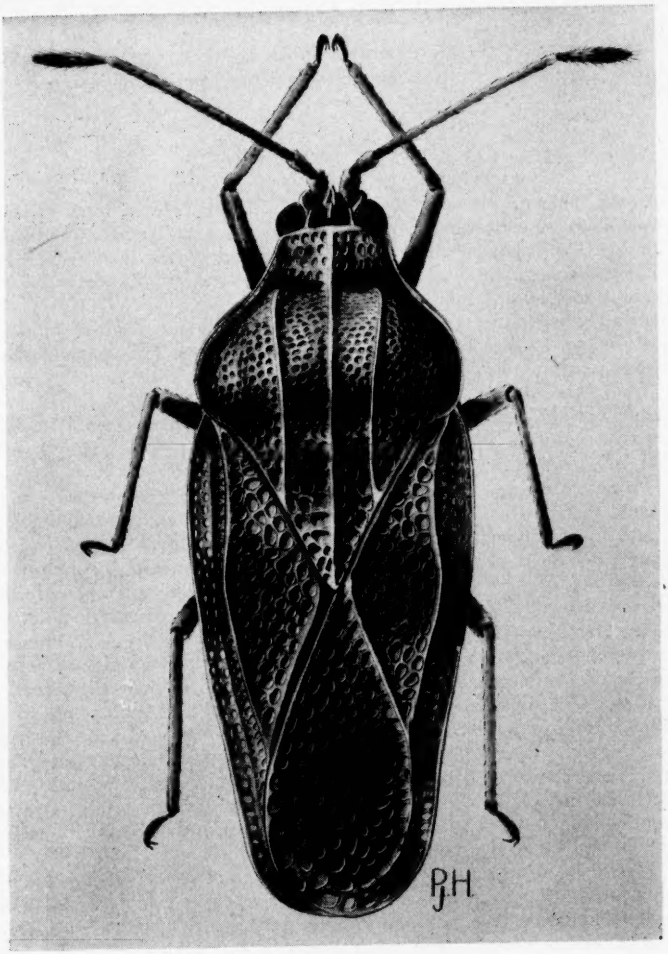


FIG. 1. *Physatocheila irregularis* Montrouzier.

boundary vein nearly straight, nine areolae deep in widest part; sutural area on same horizontal level as that of discoidal, the areolae larger.

Holotype (female), Sahara, south of Tibesti, Chad, Union of Central African Republic; elevation 1,900 meters, Nov., 1956. *Paratype:* one female, same label as type.

There are also three males, same data as type, that appear to be the same species. Two of these specimens are testaceous with only feeble indications of fuscous markings; the other specimen is reddish brown with markings scarcely indicated.

The narrow costal area, uniseriate median carina, and prominent fuscous markings separate it from other members of the genus found in northern Africa. The holotype is illustrated.

Cysteochila phae, n. sp.

Fig. 3

Small, oblong. Brownish testaceous to reddish brown; body beneath brown, with sternal laminae of rostral sulcus testaceous. Antenna testaceous, with first two segments brown and last segment brown to fuscous. Legs testaceous, femora more or less reddish brown. Length 2.25 mm., width (humeral angles) 0.80 mm.

Head very short, armed with five, moderately long, stout, suberect, brownish or testaceous spines. Labium brown, with last segment dark fuscous, reaching to middle of mesosternum; bucculae wide, areolate, closed in front. Ostiole and ostiolar canal present on each metapleuron, the channel upright, sides raised. Hypocostal lamina uniseriate. Antenna slender, first two segments stout, segmental measurements: I, 0.11 mm.; II, 0.08 mm.; III, 0.65 mm.; IV, 0.24 mm.

Pronotum moderately convex, punctate, tricarinate; median carina more elevated than lateral pair, mostly uniseriate, strongly arched and biseriate at middle of pronotal disc, there biseriate, areolae small; lateral carinae strongly divergent anteriorly, less elevated than median carina, composed of one row of minute cells; paranota moderately wide, reflexed, covering anterior part of each lateral carina, sharply, narrowly elevated at humeral angles. Outer margins of paranota and elytra, upper margin of pronotal carinae, boundary veins of elytral divisions, and the inferior edge of sternal laminae of rostral sulcus beset with very slender, sharp, delicate spines.

Elytra with apices overlapping in repose; costal area moderately wide, with cross-veins slightly thickened, areolae nearly hyaline; subcostal area nearly upright, usually biseriate, rarely completely triseriate; discoidal area large, extending beyond middle of elytra, with outer boundary vein moderately sinuate, eight or nine areolae deep in widest part; sutural area on same horizontal level as discoidal area. Legs furnished with numerous spinulae and flattened, seta-like hairs.

Holotype (male) and *allotype* (female), macropterous, Djibouti, French Somaliland, east Africa, 1897, H. Coutier. *Paratypes:* seven specimens same locality and date as type; and four *paratypes,* Kampala, Uganda, April, 1928.

Separated at once from its congeners of northern Africa by the sharply arched median carina on pronotal disc (there biseriate), spinulescent veins

of pronotum and elytra, and the somewhat flattened, spinuliferous vestiture of legs. A paratype is illustrated.

Catoplatus horvathi (Puton) New combination

Monanthia flavipes Horváth, 1874, Berlin Ent. Zeit., vol. 18, p. 334.
Monanthia horvathi Puton, 1879, Syn. Hem.-Het. France, pt. 2, p. 119.

Since the specific names of the European *Catoplatus flavipes* (Horváth) (described as *Monanthia flavipes* Horváth) and the Madagascarian *Dictyla*

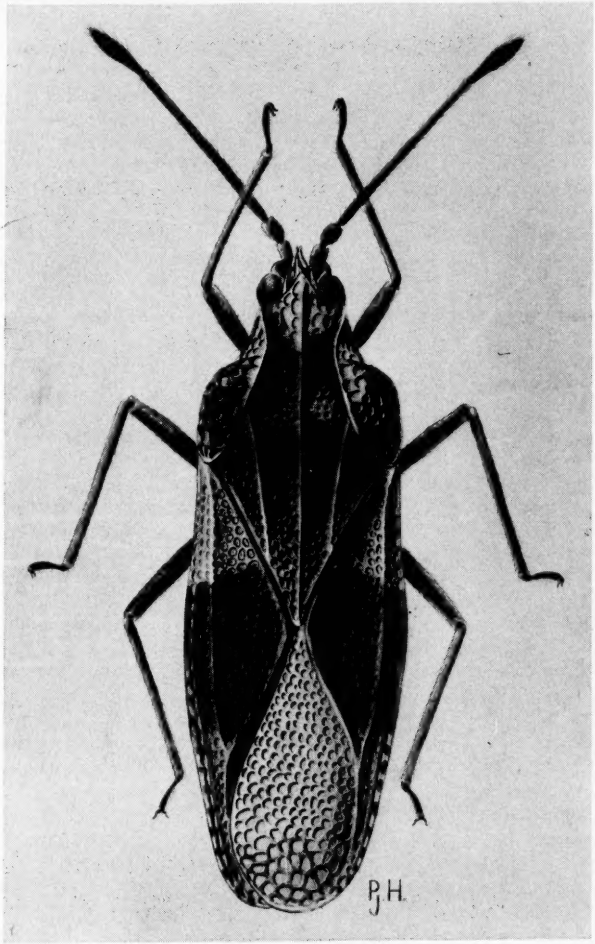


FIG. 2. *Cysteochila poecilia*, n. sp.

flavipes (Signoret) (1861) (described as *Monanthia flavipes* Signoret) are homonyms, it is necessary to resurrect *M. horvathi* Puton as the available name, *Catoplatus horvathi* (Puton), for *C. flavipes* (Horváth).

Cochlochila lewisi (Scott) New combination

Leptodictya lewisi Scott, 1880, Trans. Ent. Soc. London, pt. 4, p. 314.—Takeya, 1951, Kurume Univ. Jour. (Nat. Hist.), vol. 4, p. 20.

Monanthia conchata Matsumura, 1913, Thousand Insects of Japan, Add. 1, p. 151, pl. 14, fig. 16. (New synonymy.)

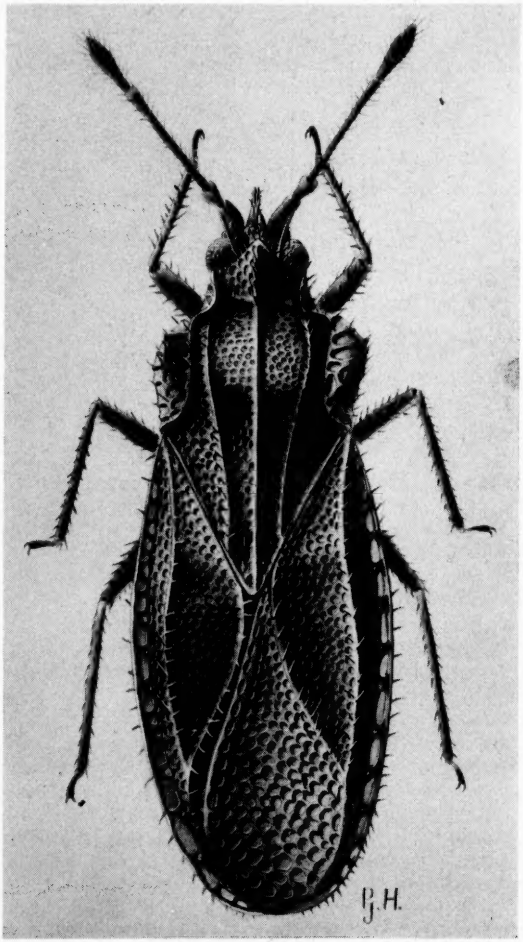


FIG. 3. *Cysteochila phae*, n. sp.

Physodictyon vesicarius Lindberg, 1927, Act. Soc. Faun. Flor. Fennica, vol. 56, p. 17, fig. 7.
Cochlochila conchata: Takeya, 1951, Kurume Univ. Journ. (Nat. Sci.), vol. 4, p. 22.

The holotype of this species cannot be found in the Scott Collection (British Museum) and thus is apparently lost. A study of specimens of *conchata* Matsumura from Japan (including one specimen netted by Scott), China, and Russia (Siberia) shows that *lewisi* Scott (based upon original description) is apparently inseparable from *conchata.* (New Synonymy.)

Habrochila darthula (Kirkaldy) New combination

Galeatus darthula Kirkaldy, 1902, Bombay Nat. Hist. Soc., vol. 14, p. 297.—Distant, 1903, Fauna British India, vol. 2, p. 131, fig. 94.

An examination of specimens of *G. darthula* Kirkaldy from Ceylon and India shows that it is a typical member of the genus *Habrochila* Horváth. The lateral carinae are each composed of one very short, fairly high, aurate cell with hind margin attached to front face of the large, inflated, posterior process of the pronotum. These carinae are small and usually overlooked in descriptions and not shown in illustrations.

BIOLOGY OF THE BROWN STINK BUG, *EUSCHISTUS SERVUS* SAY[1]

L. H. ROLSTON AND R. L. KENDRICK

The brown stink bug is an occasional pest of tomatoes, snap beans, southern peas and okra in Arkansas. The edible parts of these vegetables may be blemished or deformed by feeding punctures and defiled by the odorous secretion of the insect. Vegetables are attacked most often in late summer, and principally by adults, suggesting a migration from weeds or field crops that are no longer suitable hosts.

SEASONAL HISTORY. The seasonal history has been deduced from rearing data for the most part. The bug was reared in an insectary on snap beans during all or part of the 1957, 1958 or 1960 seasons.

Overwintering adults were active in the field in Northwest Arkansas as early as March 6, although they were not numerous until the middle of April. One overwintering female lived in captivity until September 27.

First generation eggs were deposited from April 30 until September 15, and nymphs of this generation hatched from May 11 until September 21. Some of the last nymphs to hatch did not complete their development before killing frost. First generation adults began appearing on June 25, and most of these adults entered hibernation in the fall.

[1] Published with the approval of the Director of the Arkansas Agricultural Experiment Station, Fayetteville, Arkansas.

Second generation eggs were deposited from August 3 until October 10, and nymphs of this generation hatched from August 7 until October 20. The earliest nymphs to hatch became adults on October 1, and nymphs hatching as late as August 30 became adults by October 25. A few last instar nymphs transformed to adults after they were placed in hibernation cages on October 29. None of the second generation adults oviposited before entering hibernation.

THE ADULT. Caged adults overwintered successfully under crop residues, forest duff, common mullein *(Verbascum thapsus* L.*)* and other weeds. Adults and fifth instar nymphs were released in wire screen cages on October 29, 1957, and left undisturbed until survivors were counted on March 27 the following year. Five cages were placed on each type of ground cover, although there was considerable diversity of drainage and amount of ground cover within each type. A few nymphs became adults in the fall but the remainder perished during the winter. Few adults survived under crop residues, where ground cover was sparse, or in forest duff where drainage was rather poor (Table 1). Survival was higher under weeds along field borders and was greatest under mullein.

TABLE 1. Overwintering survival on various types of ground cover.

Ground Cover	Number Caged In Fall		Percent Adults Surviving*
	Nymphs	Adults	
Crop residue	50	120	4.6
Forest duff	60	120	5.8
Weeds	40	110	14.5
Mullein	30	70	28.5

* No nymphs survived.

Overwintering adults were never found hibernating in the field, although a diligent search was made under and around mullein, and numerous samples of ground trash and bunch grasses were examined. Sixteen samples of ground trash totaling 96 square yards from Union County and 31 samples totaling 419 square yards from Desha County, yielded 14 specimens of *Oebalus pugnax* (F.), 8 specimens of *Podius maculiventrus* (Say), 2 specimens of *Hymenarcys nervosa* (Say), and single specimens of *Banasa dimidiata* (Say), *Euschistus variolarius* (P. de B.), *Peribalus limbolarius* Stål and *Thyanta* sp. A single specimen of *Oebalus pugnax* (F.) was found in 85 samples of bunch grasses, mostly *Andropogon* spp., from 17 east-central counties.

The overwintering adults may live through most of the season. Of 126 adults collected in the spring of 1958 and 1960, 70.6 percent were alive on June 1, 47.6 percent on July 1, 25.4 percent on August 1, and 12.7 percent on September 1. One female lived until September 27 in 1958, and one female lived until September 17 in 1960. There was little difference in the longevity of the sexes. The 65 females lived from two to 154 days with an average longevity of 60.6 days from the time they were collected. The 61 males lived from one to 140 days with an average longevity of 55.7 days from the time they were collected.

The 43 overwintering females collected in 1958 deposited an average of 120.8 eggs, with one individual depositing 535. Twelve females did not oviposit and 9 of these lived on longer than a week from the time they were collected. These females may have deposited their full complement of eggs the previous season.

Females of the first generation had a surprisingly long preoviposition period, ranging from 13 to 71 days and averaging 25.8 days for 189 individuals. The later in the season these females had become imagoes, the fewer the eggs deposited (Table 2). The average for the most fecund group was well below that for the overwintering females collected in the field.

TABLE 2. Fecundity and longevity of first generation adults.

	Females				Males	
Date Molted To Imago	No.	Average No. Eggs	No.	Percent Hibernating	No.	Percent Hibernating
June 25-July 15	....	....	12	33.3	11	90.9
July 16-31	36	88.9	40	62.5	44	45.4
Aug. 1-15	86	83.8	91	90.1	86	83.7
Aug. 16-31	65	39.7	81	93.8	83	85.5
Sept. 1-5	2	0.5	16	93.8	15	100
Total or Aver.	189	63.2	240	84.2	239	78.7

Adults of the first generation were disposed of on October 29 and presumably would have hibernated under natural conditions. More males than females died during late summer and fall and consequently a larger percentage of females than males entered hibernation.

A few second generation adults were reared, although most nymphs of this generation were killed by frost. All of the second generation adults entered hibernation without ovipositing.

THE EGG. Eggs are deposited on the host plant, usually in masses. Esselbaugh has described the egg and egg masses of the northern subspecies *euschistoides* (Voll.) and those of the southern subspecies apparently conform to his description (3). The 798 masses deposited by overwintering and first generation females in 1957 averaged 19.1 eggs per mass, and the 239 masses deposited by overwintering females in 1958 averaged 23.2 eggs per mass. Egg masses of 14, 28 and 42 eggs, multiples of 14, occurred most frequently. (Fig. 1 and 2). This was especially noticeable in the egg masses deposited by overwintering females collected in the spring of 1958 (Fig. 2). The same trend in frequency distribution has been observed for *E. variolarius* (P. de B.) (6).

The incubation period was observed to range from 3 to 14 days. The average incubation period for 1452 eggs of the overwintering and first generation females reared in 1957 and 1958 was 4.8 days, while that for 965 eggs from first generation adults reared in 1960 was 6.1 days.

THE NYMPH. The brown stink bug has five nymphal instars and no deviation from this number was observed in 735 individuals of the first

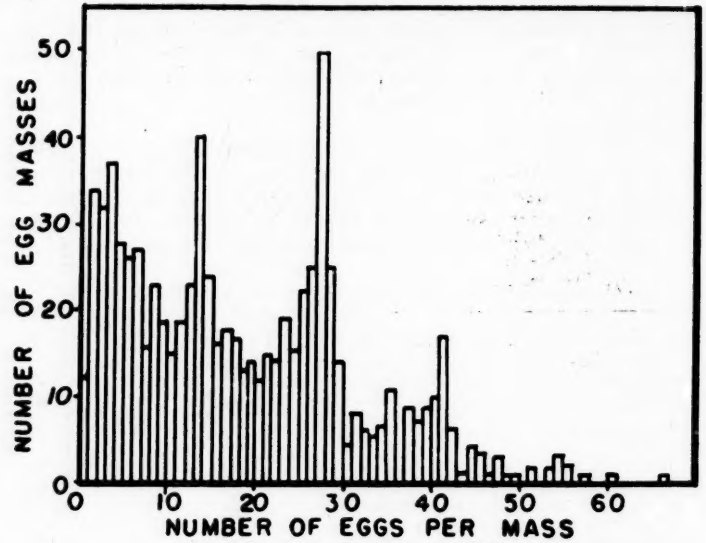


FIG. 1. Frequency of egg mass size (1957).

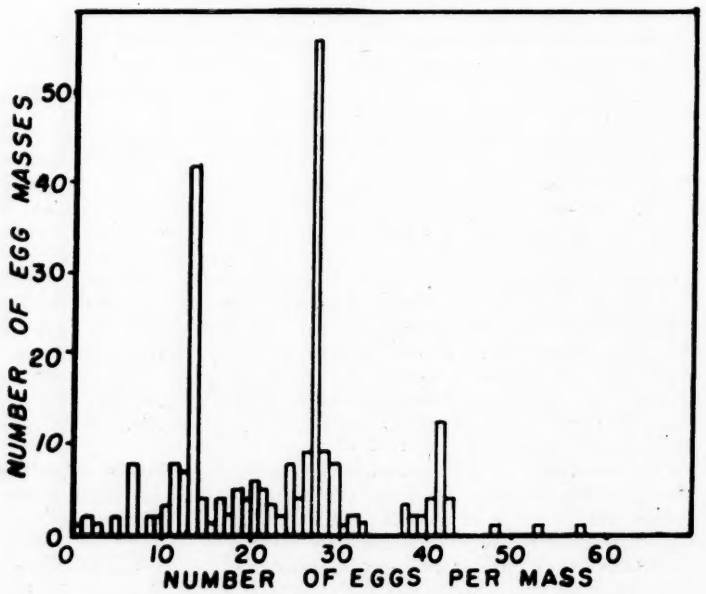


FIG. 2. Frequency of egg mass size (1958).

and second generations reared to adults. The entire nymphal stage was completed in an average of 33.3 days, but individual nymphs required as few as 23 and as many as 63 days (Table 3). The combined egg and nymphal stages were completed in an average of 38.1 days.

TABLE 3. Duration of nymphal stadia.

Instars	Number of Insects	Days		
		Min.	Max.	Aver.
1	1124	2	8	3.7
1-2	954	6	13	8.8
1-3	863	10	24	13.7
1-4	798	15	38	20.6
1-5	735	23	63	33.3

The correlation coefficient for the duration of the nymphal stage and the mean temperature was highly significant, and the coefficient of determination indicated that 89 percent of the variation in the duration of the nymphal stage was due to temperature.

Woodside, in Virginia, reared two consecutive generations of *servus* on peach foliage and ripe tomatoes (9). The imago was reached in an average of 51.5 and 54.9 days. The relatively long nymphal stage was probably a response to low mean temperatures rather than to host, for the average incubation period was 9.3 and 8.1 days. However, Woodside observed that individuals reared entirely on peach foliage and fruit were abnormally small.

Esselbaugh, in Illinois, reared the northern subspecies *euschistoides* (Voll.) through the nymphal stage in an average of 47.8 days (4). Adair, in Texas, reared what he believed to be *euschistoides* to the imago on green peas and tomatoes in an average of 35.5 days (1). In view of the northern distribution of *euschistoides,* it seems probable that the insect was actually *servus.*

Hosts. The brown stink bug has been reported to feed on a large number of very diverse plants (1, 2, 4, 5, 8, 9, 10). It has been reared successfully on peaches (9) and beans (7) and has been observed to complete its life cycle in the field on white-top fleabane, *Erigeron annuus* Pers., white campion, *Lychnus alba* Mill., and horseweed, *Erigeron canadensis* L. (10).

Common mullein is apparently important in the seasonal succession of host plants, bridging the period between early emergence of overwintering adults and the appearance of other hosts. Overwintering adults appear on mullein as early as March but are most numerous in May. A few adults may be found on mullein throughout the season. No eggs or nymphs of the brown stink bug were found on mullein in the field, and nymphs did not survive on potted plants in the insectary. Overwintering adults, collected May 18, were able to survive for some time on mullein, although it was less satisfactory than snap beans as a host (Table 4). Unfed adults died within a few days.

The brown stink bug was taken regularly in small numbers on several field crops. The legumes appeared to be more important as hosts than mixtures of weeds (Table 5). In addition to those crops listed in the table, the

insect was swept from crimson clover, orchard grass, reed canary grass and soybeans. None of the field crops appeared to be an outstanding host, although any of them could serve as a reservoir for migration to a relatively small acreage of vegetables.

TABLE 4. Survival of overwintering adults on common mullein and snap beans.

Host	Number		Days Survived	
	Males	Females	Range	Average
Snap beans	8	17	6-101	57.4
Common mullein	8	12	8-50	34.4

TABLE 5. Seasonal abundance of adult brown stink bugs on various field crops and common mullein.

Plant	Apr.	May	June	July	Aug.	Sept.	Oct.
			Per 100 Sweeps				
Alfalfa	.25	.83	.61	.23	0	.12	.10
Clover, Red	0	1.00	2.00	.63	.50	.16	0
Clover, White	..	1.00	4.00	.40	.12	..	0
Lespedeza	0	4.00	..	0	0	.25	.10
Oats	0	.57	.88	(harvested)			
Weeds	0	.44	1.70	0	0	0	0
			Per 10 Plants				
Mullein	1.88	9.25	1.85	3.10	2.23	.76	.56

Parasites. Several dipterous larvae emerged from overwintering adults collected in the field. Those parasites becoming imagoes were determined by C. W. Sabrosky as *Gymnosoma fuliginosa* R. D. and *Cylindromyia binotata* (Big.). The incidence of parasitization was usually low but reached 18.6 percent in one lot.

Summary. The brown stink bug is an occasional pest of several vegetable crops in Arkansas. There are two generations in the northwestern section of the state, but relatively few of the second generation nymphs attain the adult stage. The insect overwinters as adults and feeds on common mullein in the spring before other hosts become available. The bug was collected in small numbers on several field crops, none of which appear to be particularly favored as a host.

LITERATURE CITED

1. Adair, H. S. 1932. Black pit of pecan and some insects causing it. U. S. Dept. Agr. Cir. 234.
2. Anon. 1955. Ninth annual conference report on cotton insect research and control. pp. 45-46.
3. Esselbaugh, Charles O. 1946. A study of the eggs of Pentatomidae (Hemiptera) Ann. Ent. Soc. Amer. 39(4):667-691.
4. ———. 1948. Notes on the bionomics of some mid-western Pentatomidae. Ent. Amer. 28(1):1-73.
5. Riherd, Paul T. 1949. Chlorinated insecticides for control of cowpea insects. Jour. Econ. Ent. 42:991-992.

6. Rings, Roy W. and Robert F. Brooks. 1958. Bionomics of the one-spot stink bug in Ohio. Ohio Agr. Expt. Sta. Res. Cir. 50.
7. Sailor, R. I. 1952. A technique for rearing certain Hemiptera. U. S. Dept. Agr., Bur. Ent. and Plant Quar. ET-303.
8. Stoner, Dayton. 1922. The Scutelleroidea of the Douglas Lake region. Univ. Iowa Studies Nat. Hist. 10:45-65.
9. Woodside, A. M. 1944. Life history studies of *Euschistus servus* and *E. tristigmus*. Jour. Econ. Ent. 39(2):161-163.
10. ———. 1947. Weed hosts of bugs which cause cat-facing of peaches in Virginia. Jour. Econ. Ent. 40(2):231-233.

TWO NEW *PELECYPHORUS* FROM CALIFORNIA

(Notes on North American Coleoptera, No. 13)

CHARLES S. PAPP
Riverside, California

Some of the Tenebrionidae from the collection of the Department of Biological Control, Citrus Experiment Station, Riverside, are loaned to me for study by Prof. P. H. Timberlake. In this material the writer found one of the herein described new species from the Yucca Valley, collected by Timberlake. The other new species, the first specimen of *Pelecyphorus* ever collected in the Box Springs Mts. near Riverside, California, was taken by Charles E. Papp, Jr.

Pelecyphorus rugosus Papp, n. sp.

(Fig. 1. A-C)

Type locality: Yucca Valley, California, September 28, 1944. One male. *Head* wider than long; the frontal third with a gradual impression parallel to anterior margin of head. Pre-ocellar tip very prominent and dull, the post-ocellar very weakly developed, with a shallow impression about anterior half of eye-region. Surface with small, more or less rounded, deeply set punctuation; surface between those punctures very finely granulated. Anterior margin with very short yellowish-brown setae. Jaws two-pointed, slightly longer than wide; interior margin highly polished, exterior roughly granulate-punctate and sporadically covered with brownish erect setae; in the interior half with a sharp longitudinal impression; in the apical portion with 6-7 deeply set grooves. Labium with rounded punctures and with dense brownish hairs on the slightly dentulated anterior margin. Antennae black. *Pronotum* approximately one-third wider than long; anterior margin seen from a directly dorsal position more or less straight (Fig. 1.-A), but when seen slightly from the anteriorly dorsal direction it shows a more curved concave form. Posterior margin almost straight with slight indentation in middle behind the sharp depression. Side margins very heavily annulated, and the side-plates very coarsely and densely granulated. Elevated middle portion moderately punctuated, the punctures somewhat triangular in shape. Anterior corners sharply, posteriors slightly, pronounced. *Elytra*

with a more or less silky impression in tone, the first and second longitudinal costae sharply elevated, and a third slightly indicated and shorter; each costa in bright light appears as a row of small shiny pearls (Fig. 1. B-C). The sutural line and groove somewhat elevated (B), but surface between two second costae flatter, especially anteriorly from posterior third of elytra, the dorsal height-limit is indicated on Fig. 1-B with a dotted "T". The silky surface between the first and second costae densely, the remaining sporadically, decorated with shiny microscopic tubercles which are more prominent behind the sharply projected shoulder, where the two costae slightly touch each other. *Venter* densely punctuated with very fine punctures. Epipleural region blackish-brown, also low elytral margin. All legs shiny, especially the posteriors which are heavily granulated; the femur without setae, the rest sporadically covered with short suberect black (tibia) or dark brown (tarsi) setae. The two spines on posterior end of tibia as long as the third tarsal segment and, like the claws, dark brown. Claws as long as half of least tarsal segment. Length, 16 mm. Width, 8 mm. at widest point on the elytra.

The unique male specimen collected by Prof. P .H. Timberlake on September 28, 1944, in Yucca Valley, southern California, is labeled "nabbed by a spider." It is in the collection of the Department of Biological Control, Citrus Experiment Station, Riverside, California.

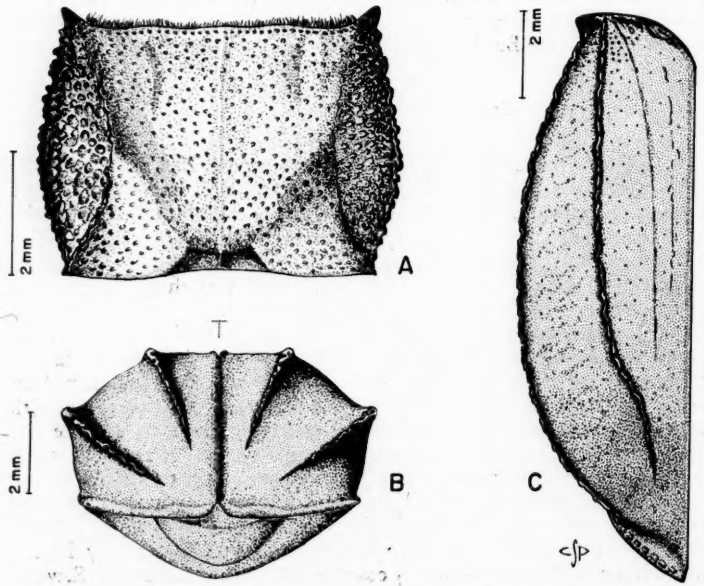


FIG. 1: *Pelecyphorus rugosus* Papp, new species. A=pronotum; B=anal view; C= the left elytron.

Pelecyphorus laevigatus Papp, n. sp.
(Fig. 2. A-C)

Type locality: Western slopes of the Box Springs Mountains, near Riverside, southern California, December 23, 1960. In general at first glance this species resembles the small mountain variety of the European *Carabus violaceus*. Slightly smaller than *porcatus*, the silky effect of the surface is replaced by some "semi-shiny" glaze. *Head* slightly wider than long, with a widely rounded anterior angle in front of the deeply set eyes. Surface very densely but coarsely punctured; anterior half covered with deep large punctures; posterior half with shallow, smaller, round punctures. Vertex in form of an upside-down "T" very deeply impressed. Frontal margin sharply concave and densely covered with yellowish hairs. Maxillae two-pointed, roughly granulated exteriorly. Labium on frontal half with large, deep punctures. Antennae, with the exception of the apical brown segment, entirely black and densely covered with black setae. *Pronotum* slightly wider than long and sharply carinate on front, almost even on its posterior end (Fig. 2-A). Sides slightly rounded and finely annulated, annules shiny

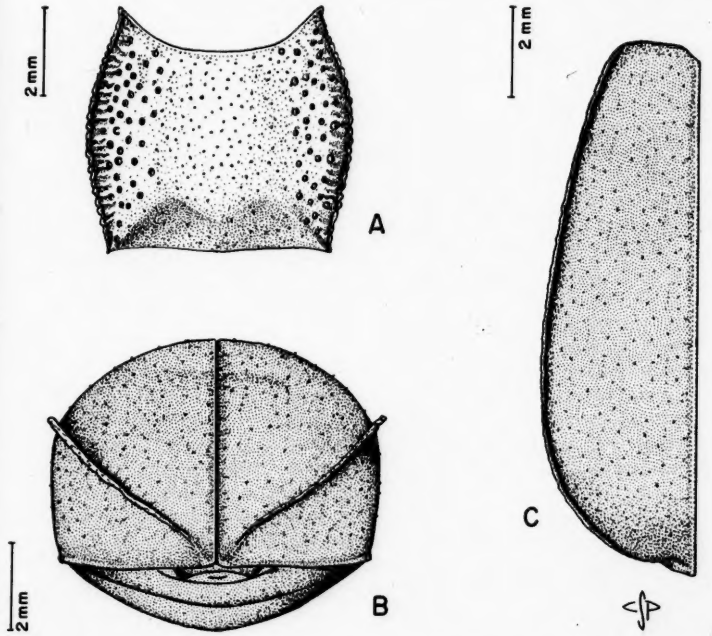


FIG. 2. *Pelecyphorus laevigatus* Papp, new species. A=pronotum; B=anal view; C= the left elytron.

and finely granulated near the edge. Toward middle of pronotum several large deep-set punctures; on the posterior third, sharply elevated center portion with somewhat finer, but deeply set punctures (Fig. 2-A). Posterior third with sharp slope toward the hind margin. *Elytra* (Fig. 2, B-C) smooth with evenly rounded shoulders; wider in posterior half with short apical projection (C). Margin shallow and hardly visible; the only costa present sharply elevated, irregularly but smoothly annulate and shiny. The anal view resembles a slightly pressed sphere (B). The surface with a hazy shine, smooth and sporadically covered with very small pointed granules, which are more dense between the elytral margin and the only costa. *Venter* very densely covered with very small pointed granules, otherwise smooth and black. Legs black, femurs roughly granulated and toward posterior end on dorsal side with longer fine black setae; tibiae very finely granulated, on dorsal side with fine black, on ventral side with somewhat longer golden-yellowish setae placed more densely toward posterior end, where the usual two spines are very short and thin. Tarsi black and densely covered with golden-yellowish setae ventrally, fine black setae dorsally. The claws dark brown and about one third as long as fourth tarsal segment. Length, 14 mm. Width, 7.2 mm. at widest point in posterior fourth of elytra.

This species is described from a unique male specimen in the writer's collection, from the Box Springs Mountains, from cismontane, very rocky and dry slopes with the typical sagebrush vegetation. Collected by Charles E. Papp., Jr., on December 23, 1960.

NOTICE TO CONTRIBUTORS

For uniformity and for economy of space, authors are requested to give generic and specific descriptions in telegraphic style, *i.e.* with minimal use of articles and verbs. Synonymies, bibliographies, paragraphing and punctuation will be edited to conform with the style used generally in this issue unless the author, when submitting his manuscript, specifically asks that no such changes be made.

Our low subscription rate makes it necessary that the cost of cuts for illustrations be borne by the author or his sponsoring agency. Also, because of limitations of page space, manuscripts ordinarily will be accepted only from members of the society or subscribers to the journal.

CHARGE TO AUTHORS FOR REPRINTS

Number of Reprints	*Charge per page*	*Min'm. chg. 1-2 pages*
100	1.35	3.75
150	1.68	4.50
200	2.01	5.25
250	2.34	6.00
300	2.67	6.75
350	3.00	7.50
400	3.33	8.25
450	3.66	9.00
500	3.99	9.75

PRICE OF BACK VOLUMES

$4.00 per volume or $1.00 per single issue

Subscriptions for back volumes or numbers should be sent to Carl W. Rettenmeyer, Department of Entomology, Kansas State University, Manhattan, Kansas.

CONTENTS OF THIS NUMBER

The Nasal Mites of the Genus *Ptilonyssus* (Acarina: Rhinonyssidae) Occurring in Some North American Passeriform Birds
JOHN EDWIN GEORGE 105

The Relationship of Spider Mite Infestation in Cotton to Early Season Use of Insecticides
W. P. BOYER AND ROBERT BELL 132

Biological Observations on *Hemihalictus lustrans,* with a Description of the Larva (Hymenoptera: Halictidae)
HOWELL V. DALY 134

Seed Cleaning as a Source of Infestation for Stored Grain
PHIL ROUSE AND L. H. ROLSTON 141

New Species and Taxonomic Changes in the Tingidae (Hemiptera)
CARL J. DRAKE AND FLORENCE A. RUHOFF 145

Biology of the Brown Stink Bug, *Euschistus servus* Say
L. H. ROLSTON AND R. L. KENDRICK 151

Two New *Pelecyphorus* from California (Notes on North American Coleoptera, No. 13)
CHARLES S. PAPP 157

105

132

134

141

145

151

157